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CONTENTS

	PAGE
Progress in the Gas Industry	549
Oxford Essays on Evolution. By W. T. C.	550
School Physics	551
The Study of Earthquakes. By C. D.	552
Aluminium, Potassium and Magnesium	553
Phenomena of Gaseous Discharges	554
The Orient and Europe. By Prof. V. Gordon Childe	557
Soil Erosion in India. By Dr. R. Maclagan Gorrie	560
Obituary Notices:	
Dr. Leo Frobenius	562
Mr. W. R. Barclay, O.B.E.	562
News and Views	563
Letters to the Editor:	
Effect of Increasing Doses of X-Radiation on Colloidal Gold.—Prof. J. A. Crowther	569
Structure of Age-Hardened Aluminium-Copper Alloys.—André Guinier; G. D. Preston	569
The Swelling of Birch Wood.—Dr. N. A. de Bruyne	570
Concentration and Measurement of Atmospheric Ozone.—Dr. William C. Reynolds; Prof. F. A. Paneth and J. L. Edgar	571
Neutrons and the Origin of Life.—Dr. John Tandberg	572
Condensation Coefficients of Mercury Halides.—F. Metzger and Dr. E. Miescher	572
Probable Dissociation of Nitrogen Molecules in the High Atmosphere.—Prof. J. Gauzit	572
Angular Distribution of Electron Pairs.—J. C. Jaeger and Dr. H. R. Hulme	573
Chemical Nature of Proliferation-Promoting Factors from Injured Cells.—Prof. John R. Loofbourow, Elton S. Cook and Sister Miriam Michael Stimson	573
Mutation of the Blood-Group Genes.—Dr. Ronald Elsdon-Dew	575
Pleistocene Site in the Malay Peninsula.—H. D. Collings	575
Dry Crossing of the Nile.—Captain C. J. P. Cave	576
Distribution of the Polychæte *Ophelia cluthensis* McGuire.—C. B. Rees	576
Connexions of the Pterygoquadrate in the Tadpole of *Philautus variabilis* (Anura).—Dr. L. S. Ramaswami	577
Differentiation of Heterochromatic Regions during Meiosis.—Prof. Dontcho Kostoff	577
Research Items	579
Vector Maps and Crystal Analysis. By Dr. Irving Langmuir and Dr. Dorothy Wrinch	581
Marine Research in the Antarctic	583
Progress in Building Research	584
Australian Echinoderms. By D. D. J.	585
Science News a Century Ago	586
Societies and Academies	586

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Progress in the Gas Industry

THE majority of our large industries can claim to-day to be well managed. Two major depressions since the Great War and the need of continuous adjustment to changing world conditions, including the altered views towards labour at home, have provided a stimulus to which even the most conventional and conservative have been forced to react. The more successful industries are those which have favoured research both into new processes and to bettering existing practice. In the steel industry, for example, every time a new plant is erected—and there have been several in recent years—it represents all the most modern views with the addition generally of something new, peculiar to the particular plant. If successful, this novelty is copied in the next plant, though others in the industry can only benefit when the next new plant is built. Such an industry must bear a very high rate of depreciation if it is to replace its plant at reasonable intervals, and it has to solve some very difficult financial problems. In certain industries the amount of capital locked up in a particular type of plant is large, so that a new development which involves the scrapping of this plant whilst it is still in first-class condition is looked at askance.

Whilst it is the prime duty of management to carry on a business as it exists, seeking any and every way of increasing efficiency in all departments, nothing is lost by occasionally reviewing the possibilities in quite other directions than what is normal practice. Whilst competition should be enough to keep industrial firms alert, the great public utilities might conceivably stagnate without the pressure of public opinion.

Probably the most discussed event of the year in the gas industry is a paper by Mr. E. V. Evans, who is chairman of the Research Executive Committee of the Institution of Gas Engineers, in which views are advanced regarding the processing of coal which involve a great departure from existing practice. Inasmuch as coal is both the chief raw material and main source of political and social controversy in Great Britain, whilst each one of us is concerned in the problems of cooking and heating, it is of interest to enlarge a little on this subject.

Two large industries carbonize coal—the gas industry, which makes gas the prime and coke a subsidiary product and also undertakes the supply of gas to every room in every house, and the coke oven industry, which makes coke for the metallurgical industries and sells gas as a by-product when possible.

The Area Gas Supply Committee under the chairmanship of Sir Alexander Walker advocated in 1930 that by means of a system of ring mains this oven gas should be collected from the coke ovens and distributed by the gas companies. The city of Sheffield has adopted this practice with success, though more recently both the Lords and the Commons have given an attentive ear to the opposition of vested interests to a proposed scheme elsewhere in Yorkshire promoted by the gas companies. This incident is both regrettable and short-sighted; it is imperative, to conserve our national resources of coal, that all gas produced at coke ovens or oil refiners should be distributed through the mains of gas companies. In the United States there are many thousands of miles of pipe line serving this purpose.

The purpose of a gas company is to supply gas, and its capital and expenditure is almost entirely devoted to this. The sale of the by-product

brought in a casual income which has been supplemented and made more regular since the industry has turned to perfecting at considerable cost the quality of coke, both in regard to size, moisture and ash content and burning qualities. In addition, the apparatus in which coke is used has been perfected so that the public is getting to use and to rely on it more and more, causing a demand for it in the colder months which roughly balances the production by the gas industry.

Mr. Evans has drawn up an illuminating balance sheet on *a thermal basis* of the gas industry. 300 therms are purchased in the form of coal for 25*s*., that is, 1·00*d*. per therm by a works some distance from the collieries, and a further 150*d*. is spent on manufacturing costs exclusive of capital charges. 72 therms are used during the process, so that the cost per therm of the products is 450/228 = 1·97*d*. per therm.

There are three products, namely, 75 therms of gas, 135 therms of coke, 18 therms of tar. The coke sells at the works at 1*d*. per therm (a working loss of 0·97*d*.) and the tar at 1·85*d*. per therm, a loss of 0·12*d*. on each therm. If these losses are computed per therm of gas they amount to 1·78*d*., making a total manufacturing cost for gas of 3·75*d*. per therm into the holder ready to be distributed. If gas is to hold its own in the future it should be cheaper, particularly if it is to serve—as it should—as a staple fuel and not a luxury commodity. The industry in such circumstances will no longer be in a position to afford the continued production of coke; the public with cheap gas as a staple fuel will not need coke as a complement. Further, if gas exclusively is used in a household for which purpose the existing supply mains are adequate, the distribution costs will be decreased.

This economic survey leads to the consideration of the technical problem of the complete gasification of coal. The gas must be low in carbon monoxide and contain enough hydrocarbon gases to give it the calorific value and combustion properties which now characterize it. A new process has to be invented, and Mr. Evans described the experimental work which has led to most hopeful results; these are soon to be tested on a large scale in a specially designed plant. They are based on the discovery that large yields of methane are obtained by the direct hydrogenation of coal under pressure as it is undergoing decomposition whilst its temperature is being raised from 550° to 800° C. The production of the necessary hydrogen at a low cost is based on an earlier discovery by the Lurgi Company that coal gasified under pressure in the presence of steam and oxygen with a high proportion of the former yields a gas rich in hydrogen.

The technical details need not concern us. The picture is one of coal being charged into a vessel where it will be treated with hydrogen under pressure in such a manner that it will produce rich gas together with primary tar. When rather more than half the weight of coal has gone, the rest is fed to a producer, operating under pressure and supplied with oxygen and steam, where it is gasified to produce hydrogen. Such a works would be very much smaller than the modern gasworks; purification being done by washing under pressure would be simple, and there would be other advantages. It would, however, be entirely different from the gasworks of to-day.

The gas industry has enterprise and public spirit enough to carry through the experiment; it will take time and treasure. If it succeeds, the day will be nearer when all our heat is on tap, the streets free from carts delivering coal and coke, the skies free from smoke and our houses cleaner and more convenient.

Oxford Essays on Evolution

Evolution:
Essays on Aspects of Evolutionary Biology presented to Prof. E. S. Goodrich on his Seventieth Birthday. Edited by G. R. de Beer. Pp. viii + 352. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 15*s*. net.

FOR close on half a century, Prof. E. S. Goodrich has been engaged in zoological research and teaching in the University of Oxford. On the recent occasion of his seventieth birthday a congratulatory volume prepared by a number of his colleagues and pupils was presented to him. Instead of following the usual method of such *Festschriften* and allowing the contributors to write on any subject they might choose, the editor, Dr. G. R. de Beer, decided to prepare a planned volume on the more important aspects of modern knowledge concerning evolution. He secured the

collaboration of twenty authors, each of whom has dealt with the particular branch of the subject to which he has given special attention. The result is a work which has value as a summary of existing knowledge and current opinion, quite apart from the circumstances that led to its publication. At the same time, the very completeness of the survey bears witness to the vitality and catholicity of the Oxford school of zoology, while the fact that so many of the authors find occasion to quote from the writings of Prof. Goodrich himself is evidence of the many-sided inspiration which that school has received from him.

It is not possible here to comment on more than one or two of the nineteen essays contained in the volume, although all of them merit the attention of every biologist. The veteran Sir Edward Poulton contributes, in the first essay, a vigorous restatement of the Darwinian (or rather Batesian) explanation of insect mimicry, a restatement that will perhaps find a more ready hearing than it might have found, say, twenty-five years ago. Dr. Julian Huxley discusses the present standing of the theory of sexual selection, and concludes that "the hypothesis of female choice and of selection between rival males . . . is inapplicable to the great majority of display characters".

Mr. E. B. Ford and Prof. J. B. S. Haldane both write as geneticists, the former on the genetic basis of adaptation and the latter on the nature of inter-specific differences. One gets the impression that the chasm which, until a few years ago, yawned between genetics and the other branches of biology is being spanned, and if the bridge is not yet fit for heavy traffic, the foundations of a permanent structure are becoming visible. Dr. G. R. de Beer, in an essay on embryology and evolution, is largely concerned with attempting to redefine the concept of homology in terms furnished by the results of experimental embryology and trying to find what truth may remain in the famous theory of recapitulation. The latter theory also comes under consideration by Prof. Garstang and Dr. R. Gurney in discussing the descent of Crustacea from trilobites. Mr. J. Z. Young discusses the evolution of the nervous system, making some points of importance that will be new to most biologists. Dr. W. K. Spencer describes some primitive fossil echinoderms and makes some very interesting suggestions as to their probable habits, but perhaps over-estimates the capacity of non-specialist readers to follow his descriptions. Dr. H. A. Baylis's chapter on helminths and evolution provides an excellent example of the way in which the detailed knowledge of the systematist can be brought to bear on some of the fundamental problems of biology.

One complaint must be addressed to the editor. The deplorable modern innovation of omitting the titles of papers from the lists of references makes these lists of singularly little use.

W. T. C.

School Physics

(1) A School Physics: Revision Notes and Questions:
Hydrostatics, Heat, Light and Sound. By S. R. Humby and F. W. Goddard. Pp. viii + 235. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 3*s*.

(2) Concise School Physics:
Mechanics. By R. G. Shackel. Pp. vii + 184. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 2*s*. 9*d*.

(3) Electricity and Magnetism
By Dr. R. G. Mitton. (Dent's Modern Science Series.) Pp. x + 272. (London: J. M. Dent and Sons, Ltd., 1937.) 3*s*. 6*d*.

SCHOOL text-books of science sometimes fall between two stools. They should either be so fully written and so easily read that the pupil can learn his subject from them with the minimum of help from his teacher, or they should be so strictly abridged that the teacher is not embarrassed when he tries to develop the work along his own lines. Too often a beginner is only hampered by having a new subject presented to him in two different ways at the start. Messrs. Humby and Goddard and Mr. Shackel have avoided this difficulty in their two books, in which there are many points of resemblance; for they offer the pupils a clear outline of their subjects, supported by a great number of questions taken from examination papers of matriculation standard.

(1) The authors of "A School Physics" state that their book is intended primarily for use as a final revision for students taking the various school certificate and matriculation examinations, and for those beginning an advanced course in physics. For this purpose it should prove very useful. If we must have examinations, we may as well use that incentive to the full. "A School Physics" deals with hydrostatics, heat, light and sound, but not with electricity.

(2) Mr. Shackel, in his book, confines himself to mechanics, but he includes hydrostatics, elasticity, surface tension, viscosity, diffusion and osmosis under this heading. The writing is very condensed and the general method of treatment is to define and elucidate a principle, then to provide experimental verification and lastly to proceed to practical application. Some of the experimental work which Mr. Shackel mentions is novel and many of his applications are modern. The frequent historical notes, which add to the attractiveness of the book for the adult, are perhaps too concise to make much appeal to the student, unless—as the author probably intended—they receive amplification from the teacher. This book, like the one mentioned above, should prove an effective tool to use in preparing pupils for matriculation and kindred examinations; but—better than that—it provides a sound introduction to more advanced work in physics. For students of average ability, it may prove difficult to follow, unless they get considerable help from their teachers. The latter should find it very convenient to use with their classes.

(3) Though Dr. Mitton is concerned with the formal development of one branch of science, his method is to proceed from the practical aspects in order to elucidate principles. Thus, in his preface, the author says: "Most students are interested in the practical applications of electricity, and it must be the aim of a text-book to develop this latent interest, as well as to present the fundamental principles of the subject in an attractive form." "For this reason," he goes on to say, "although the requirements of students preparing for School Certificate Examinations have been a primary consideration, the scope of this book has not been limited by a narrow interpretation of the requirements of any examination syllabus, but has been extended to include a short account of alternating currents, and of modern discoveries in electricity."

A perusal of the book certainly bears out his claims. The treatment is sometimes rather didatic, but there is a unity and a coherence much more marked than usual in this type of work, and the numerical examples given in the text are often admirably chosen to help the argument. When it is shown, for example, that to transmit electrical energy at 220 volts instead of 132,000 volts without increasing the loss would need a cable of more than 22 feet in diameter, the object of transformers is certainly brought home! The chapters on static electricity make somewhat heavy reading, but the whole book strikes one as a sound, well-planned piece of work, which is both attractive and stimulating.

The Study of Earthquakes

Theoretical and Applied Seismology

By Dr. Akitune Imamura. Pp. xi + 358. (Tokyo: Maruzen Co., Ltd., 1937.) 7 yen.

SINCE the early years of the present century, Prof. Imamura has been widely known as one of the most active and capable of Japanese seismologists. On the death of Prof. Omori in 1923, he succeeded to offices held by him, his first duty being the investigation of the great Kwanto earthquake of that year. He has also made valuable studies on the displacements of the crust in connexion with Japanese earthquakes. In 1931, he retired from the professorship of seismology in the Imperial University of Tokyo, and the notes that he had collected for many courses of lectures form the foundation of the present volume.

A noteworthy feature of the book is the number of references to the work of foreign seismologists. Yet there are some curious omissions. It is difficult to understand how, in a volume so largely devoted to the earthquakes of Japan, the achievements of Prof. Milne in that country should never once be mentioned. There are brief references to his catalogue of destructive earthquakes, to his well-known seismograph and to the reports of the British Association Committee, but no one would gather from these pages that he was the founder of the Seismological Society of Japan, or the man whose work led up to the present organization of earthquake studies in that country. Again, in the chapter on "some great earthquakes", the descriptions of the California earthquake of 1906 and the Messina earthquake of 1908 are both founded on preliminary reports of Prof. Omori. The detailed accounts of the former earthquake edited by Profs. Lawson and Reid and of the latter written by Prof. Baratta are not referred to.

Serious as these omissions are, Prof. Imamura's book is a valuable addition to our list of earthquake manuals. Some of the sections dealing with Japanese earthquakes will be found of special interest to European readers, such as those on the displacements of the crust connected with great earthquakes, the Sanriku sea-waves of 1896, the distribution of the earthquakes with the catalogue of severe earthquakes since 1596, and the accounts of the great earthquakes of 1707, 1891, 1923 and 1927.

In one important respect, the book differs from its predecessors, in the special attention devoted to the practical applications of seismology. The final chapter on the mitigation of earthquake disasters deals with the selection of the site, the construction of earthquake-proof buildings, and the measures to be taken if fires should break out, ending with a section, as useful as it is unusual, on the behaviour of human beings during earthquakes. The chapter on the effects of earthquakes on water closes with similar, and equally practical, advice on the mitigation of the disasters caused by earthquake sea-waves.

C. D.

Aluminium, Potassium and Magnesium

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der deutschen chemischen Gesellschaft. (Berlin: Verlag Chemie G.m.b.H., 1937.)

(1) System-Nummer 35: Aluminium. Teil A, Lief. 5: Legierungen von Aluminium mit Zink bis Uran. Pp. 683–886 + xvi. 24.75 gold marks.

(2) System-Nummer 22: Kalium. Lief. 3: Verbindungen bis Kalium und Tellur. Pp. 515–804. 35.25 gold marks.

(3) and (4). System-Nummer 27: Magnesium. Teil A, Lief. 1: Vorkommen; Darstellung des Metalls. Pp. 156. 18 gold marks. Teil A, Lief. 2: Eigenschaften des Metalls. Pp. 157–372. 25.50 gold marks.

(5) Magnesium-Legierungen. Patentsammlung. Von A. Grützner, unter Mitarbeit von G. Apel und C. Götze. Zugleich Anhang zu Magnesium Teil A in Gmelins "Handbuch der anorganischen Chemie". Pp. vii + 192. 15 gold marks.

(1) THE systematic description of the alloys of aluminium is continued in the part of "Gmelins Handbuch" under notice. A long range of metals including zinc, mercury, tin, lead, chromium, tungsten and most of the rarer metals is covered and more than a hundred diagrams illustrate the variations in physical properties.

Aluminium and zinc mix completely in the liquid condition, but at room temperature a maximum solubility of 18 per cent of zinc is indicated by a marked discontinuity in the conductivity curve. Solubility in caustic alkalis falls rapidly and in dilute acids rises as the proportion of zinc is increased, both curves showing breaks at the concentration corresponding to the composition Al_2Zn_3. Aluminium dissolves very slightly in mercury; amalgamation occurs at the boiling-point of the latter and also in certain chemical reactions, but the products in the latter case are never uniform. The amalgam reacts easily with water and provides a convenient neutral reducing agent in organic reactions.

Lanthanum and cerium show pronounced maxima at temperatures somewhat above 1400° C. Tin and aluminium can be melted together and form an eutectic with 99·5 per cent of tin, but in the solid state the mutual solubilities are extremely small and the alloys are readily corroded by water. Lead mixes only to a very slight extent even in the liquid condition, whilst the data about chromium are contradictory.

(2) Compounds of potassium with bromine, iodine, sulphur, selenium and tellurium are described in the second volume under notice. Naturally the halides and sulphate receive most attention. For exact work on the determination of equivalent weights, pure potassium bromide has been prepared from bromine vapour and neutral potassium oxalate, which react with liberation of carbon dioxide.

The solubility of potassium iodide in different solvents has received much attention. The diagram illustrating the solubility of the salt in liquid sulphur dioxide shows the existence of two compounds containing four and fourteen molecules respectively of sulphur dioxide combined with one of potassium iodide. Several anhydrous polyhalides of potassium with either three or five halogen atoms per molecule have been isolated, but poly-iodides are unknown in the unsolvated condition. Thus the tri-iodide is combined with one molecule of water or two of benzonitrile. A poly-iodide of the composition $KI_9 \cdot 3C_6H_6$ has also been obtained.

The complex system between potassium sulphate, sulphuric acid and water is described in full detail. Potassium sulphate behaves in a remarkable fashion with potassium fluoride since the compound which they form is only stable above 578° C. Undoubted evidence of its existence is provided not only by the appearance of two eutectic points on the phase-rule diagram but also by the strongly marked depression in the curve of specific conductivity.

(3) and (4). In recent years magnesium has sprung into prominence on account of the importance of some of its alloys. Although exact production figures are not yet available, it has been estimated that the world's output of the metal has risen from about 300 tons in 1926 to many thousands of tons per annum, the demand having

increased suddenly about three years ago. Minerals containing magnesium were used by the ancient Greeks and Romans, but it was Black who first distinguished clearly between lime and magnesia in 1755. In 1808 Sir Humphry Davy obtained an amalgam but failed to isolate the metal. Twenty years later, Bussy reduced the fused chloride to the metallic state with the vapour of potassium, but Davy's original electrolytic method was successfully modified in 1852 by Bunsen. In view of the astonishing increase in the industrial applications of the metal in recent years, it is perhaps surprising that this method has not only survived but also has practically eliminated other competitive processes. The chief difficulty to be overcome is the elimination of water from the fused chloride, since even traces of moisture cause hydrolysis and the formation of an insulating layer of oxide. Hydrolysis is considerably lessened when potassium chloride is present, and sometimes carnallite is used. The addition of potassium chloride causes the metal to sink to the bottom in spite of its low density.

Complete dehydration of magnesium chloride is, however, difficult and other industrial processes have been successfully operated. Thus the oxide can be reduced with carbon in the electric furnace and a modification of the Hall-Héroult electrolytic process for aluminium has been adapted for magnesium. Magnesium is the lightest of all metals to withstand atmospheric corrosion, and moreover in the pure state it possesses very valuable mechanical properties. Numerous references are given to technical methods of manufacture and there is a very full description of its physical and chemical properties, including recent work on its atomic structure, isotopes and nuclear transformations under bombardment.

(5) An alphabetical register of all known alloys of magnesium, arranged on the lines of those already published for steels and aluminium alloys, with remarks on their principal uses and references to the patent literature of Germany, Great Britain, France, Austria, Switzerland and the United States from 1909 to the end of 1936, should prove invaluable to those engaged on research work in this technically important and rapidly expanding industry. References to journals are excluded, since they are given in abundance in the text.

Phenomena of Gaseous Discharges

Elektrische Gasentladungslampen
By Dr. W. Uyterhoeven. Unter Mitarbeit von Ing. K. W. Hess. Pp. ix + 364. (Berlin: Julius Springer, 1938.) 36.40 gold marks.

THE scope of this book is wider than its title suggests; this applies especially to the first two parts—the seven chapters dealing with electrons and atoms, and the general theory of discharges in gases.

These seven chapters include, in only 140 pages, practically all the fundamental physical ideas from the kinetic theory of gases to the complete discussion of the positive column. The literature up to about 1937 is considered. In order to cover as much ground as possible in this comparatively small space, the discussion of individual processes has had to be somewhat condensed. However, the non-specialized engineer will find the book provides quite a satisfactory account of the various problems, while the student reader who requires detailed solutions will obtain further information from the numerous papers which are cited at the end of the book and co-ordinated with the individual chapters. In a future edition this part of the book could, perhaps, be extended, especially as attempts have recently been made to revise the theory of the positive column, which is of prime importance in gas discharge phenomena.

Chapters viii and ix deal with light and vision, and contain a survey of colorimetry based on modern concepts, together with a short review of photometry and the efficiency of illuminants.

The later half of the book is devoted to discharge lamps—neon and mercury high-pressure (1–10 atm.) and super-high pressure (80–100 atm.). Some of these chapters will be of permanent value in so far as they discuss the complicated physical *problems* connected with the operation of such discharges and the many practical problems of auxiliary gear. The *solutions* may be looked at from a different angle in a few years time, and in addition development of the special lamp types is very rapid. The majority of the types discussed are Continental and to a great extent are taken from those of the Company in whose laboratory Uyterhoeven has done important work on the development of the discharge lamp. This slight bias is perhaps not unnatural, as the author must have had more information from his own Company than from others.

Uyterhoeven's book can be recommended as an interesting survey of a technical field which may prove absorbing to many engineers. Some of the problems also suggest lines for further research.

Our Daily Bread:
a Geography of Production. By Sir Daniel Hall. Pp. xi+169. (London: John Murray, 1938.) 6*s*. net.

WE have travelled far since Mrs. Mangnall's "Historical and Miscellaneous Questions", first published in 1800, was widely used for initiating youth into an encyclopædic knowledge that ranged from the architecture of the universe to such lowly things as the nature and sources of hemp and ginger. The seeming omniscience of the author, no less than the illogical sequence of much of the subject-matter, makes amusing reading to-day, and gives us some justification for pluming ourselves on progress since achieved. Sir Daniel Hall's latest book, written primarily for use in urban schools, marks in a very striking manner the antithesis between the old and the new ways of imparting information. In simple language and easy-flowing style, he relates all those facts about the sources of our daily foodstuffs that a developing adolescent ought to know; and a slight discursiveness here and there, as well as many excellent pictures and a few maps, adds interest to his narrative.

In one respect, however, the book resembles "Mangnall": it is purely informative, and therefore invites a criticism which the author seems to expect when he says "Education consists in something more than handing out information, but none the less it is a thin and colourless life that does not start with a basis of facts". To the scientific mind a factual basis is a *sine qua non* of every mental discipline; nevertheless, for the very young, 'fairy stories' have much to commend them, and later on a trained imagination is essential for perceiving relationships between facts, for trying to explain differences between related facts, and for drawing conclusions by 'putting two and two together'. We may therefore hope that the author will follow up this excellent introduction to the facts of agriculture with a more ambitious book that will not only inform the developing mind, but also stimulate it to *think*. *Primum pensare deinde vivere*. E. H. T.

Surface and Radiological Anatomy:
for Students and General Practitioners. By Prof. Arthur B. Appleton, Prof. William J. Hamilton and Dr. Ivan C. C. Tchaperoff. Pp. xi+311. (Cambridge: W. Heffer and Sons, Ltd., 1938.) 15*s*. net.

THE collaboration of two professors of anatomy with a radiologist has resulted in the production of a work which marks a new departure in the study of surface anatomy, and should be highly appreciated by the medical practitioner and student. The work is divided into six parts, devoted respectively to the upper limb, chest and back, abdomen, head and neck, vertebral column and lower limb, preceded by an introduction containing an account of radiological technique. There are three appendixes, containing tables of ossification, a summary of ossification and segmental innervation of muscles. The radiological methods include œsophagoscopy, gastroscopy, cystoscopy, ventriculography and encephalography.

The Subject Index to Periodicals, 1937
Pp. xxix+292. (London: The Library Association, 1938.) 70*s*.

THIS is the twenty-second year of publication of the "Subject Index to Periodicals" prepared by the Library Association. The Association and its general editor, Mr. T. Rowland Powel, are to be congratulated on the issue of the volume for 1937 only five months after the close of that year.

This volume introduces a new and valuable feature in a 'Location List' which tells the reader where he may consult the periodical mentioned. More than 170 libraries in the United Kingdom are mentioned in the list. In this list the reader is told in which libraries each of the 584 periodicals indexed may be found. There is, of course, no guarantee that the library in question would be prepared to lend its periodicals to borrowers. Of the periodicals indexed, 535 are English and American, 27 French and Belgian, 20 German and 2 Italian.

The articles indexed are arranged under subject headings such as hygiene, mine accidents, microscope, photography. The subject headings are arranged in alphabetical order, and are chosen from the alphabetical subject headings of the Library of Congress, U.S.A., with modifications and additions to suit British practice. Verse and fiction are not included.

With some important exceptions, periodicals covered by the following publications are not indexed: *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colorists*, *Photographic Abstracts*, *Revue de Géologie*, *Royal Meteorological Society Bibliography*, *Science Abstracts A and B*, *Textile Institute Journal*. There is no doubt that the Library Association is doing valuable work in preparing this annual index to the contents of periodicals.

Diet and Cancer:
an Experimental Study. By Dr. N. Waterman. Pp. v+96. (Amsterdam: D. B. Centen's Uitgevers-Maatschappij, 1938.) 2.50 dollars.

AS the result of his investigations at the Leeuwenhoek Cancer Research Institute, Amsterdam, Dr. N. Waterman, while admitting that his results are neither complete nor definitive, maintains that the influence of different foodstuffs on a definite experimental form of cancer is incontestable. His experiments, which were carried out on mice developing tar cancer, showed that of the classical foodstuffs (proteins, carbohydrates and fats) only animal fats appeared to have a definite deleterious effect, the malignancy of the process being increased to a marked degree. As regards vitamins, increase of vitamin A intake had an undoubted, if not very marked, mitigating effect on the course of tar carcinoma; administration of vitamin B_1 did not have the unfavourable effect in tar cancer which it had in inoculated tumours; and vitamin C delayed the formation of carcinoma and increased the duration of life.

A Text-Book of Convergence

By W. L. Ferrar. Pp. vii + 192. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 10*s*. 6*d*. net.

IN this book, the theory of convergence is developed on two fundamental assumptions. The first of these is concerned with upper bounds, namely, that a certain set of numbers has in it a least number; while the second refers to irrational number as the limit of a sequence of rational numbers, namely, that every irrational number is the limit of a monotonic increasing sequence of rational numbers. With the aid of these assumptions, the theory of convergence is developed without recourse to the properties of Dedekind cuts. The 'real' number appears only in the appendix, where the assumptions used in the body of the work are proved to be consequences of the definition of real number. In the appendix also, the first of the above-mentioned assumptions appears as a theorem, and a proof of the second is given. In fact, the appendix contains as much of the foundations of analysis as is necessary to justify the assumptions made in the initial chapters of the book. A short historical survey prefacing an examination of these 'foundations' shows why such a complex structure as the Dedekind cut is essential to the definition of number.

The notation used throughout the work is one familiar to all analysts; but its use in a text-book is, as the author says, somewhat of an innovation. A great improvement on the majority of text-books is that the proofs do not teem with references to previous theorems. The references are given parenthetically if at all, and the student is advised to use them as sparingly as possible in following the proofs.

Organic Reagents for Metals and for Certain Acid Radicals

By the Staff of the Research Laboratory of Hopkin and Williams, Ltd. Third edition. Pp. 156. (London: Hopkin and Williams, Ltd., 1938.) 2*s*.

THE first edition of this small work appeared in January 1933, it was reprinted in July of the same year, a second edition appeared in 1934, and now a third edition has become necessary.

About forty compounds are mentioned in the book; the systematic names (alphabetical order) are followed by trivial names, constitutional formulæ, molecular weight and salient properties. Concise directions are given for use in qualitative and quantitative work. The bibliographies for each compound are full and there is a good index. The book should be used in conjunction with "Modern Methods in Quantitative Chemical Analysis" by A. D. Mitchell and A. M. Ward.

The Conquest of Cholera:

America's Greatest Scourge. By Prof. J. S. Chambers. Pp. xv + 366 + 40 plates. (New York: The Macmillan Company, 1938.) 20*s*. net.

THIS book, which is based on the study of contemporary medical literature and old newspaper files, contains a detailed and vivid account of the epidemics of cholera which devastated the United States in 1832, 1833, 1849, 1866 and 1873. In addition to the description of the epidemics, chapters are also devoted to the contributions to medical literature between the epidemics of 1833 and 1849, the work of Pasteur and the substitution of the germ theory for the miasmatic origin of disease. The text is liberally interspersed with portraits, maps and other illustrations, and a bibliography of sixty references is appended.

Weather Rambles

By Dr. W. J. Humphreys. Pp. iv + 265. (London: Baillière, Tindall and Cox, 1937.) 11*s*. 6*d*.

IN the form of a series of chatty chapters, the author, whose larger books are well known to all students of meteorology, contrives to give a wealth of information concerning nearly all aspects of the weather in a simple form. The subjects discussed are much too varied to permit of summarizing in a few sentences. Starting with the tornado, or prairie twister, following on with the mysteries of the forms of solid condensation of water vapour and the problem of how the earth got its atmosphere, it ends with the problem of home-made weather, or the control of air conditions in enclosed spaces. This is no systematic text-book of meteorology, but contains a wealth of interesting information, all given in a clear and delightful style.

Climate:

a Treatise on the Principles of Weather and Climate. By W. G. Kendrew. Second edition. Pp. x + 328 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 15*s*. net.

THE new edition of Kendrew's book on climate gives an outline of the physical principles which underlie the variations of weather and climate. The effects of insolation, the relation of the distribution of pressure to wind systems, the formation of precipitation and of fog, the effect of elevation above sea-level on climatic factors, and a fairly detailed description of the weather of the temperate regions, form the most important features of the book.

This book is an interesting and valuable introduction to the study of climatology, and is so clearly written that it requires no special technical knowledge of the reader.

An Introduction to Weather and Climate

By Prof. Glenn T. Trewartha. (McGraw-Hill Series in Geography.) Pp. ix + 373 + 7 plates. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18*s*.

THE first half of Prof. Trewartha's book is devoted to the physical bases of weather and climate. While this contains a considerable amount of information, it cannot be regarded as free from errors, and so is perhaps not the perfect introduction to the second part of the book, which deals with the classification of climates in accordance with a scheme which is a slight variant of the Köppen classification. The second part of the book is clearly written, and can be recommended as an introduction to the longer treatises on the subject.

The Orient and Europe*

By Prof. V. Gordon Childe

TEN years of excavation throughout the Old World have yielded results startling enough to affect our concrete picture of human history. From this vast field I want to gather together some new facts that should mould our total synthesis. But my aim in so doing will be not to attempt in an hour an impossible reconstruction of human history. I shall rather focus attention on some new data which will permit a concrete answer to a rather abstract question. Why is a prehistorian asked to preside over a section in this Association from which historians, as such, would be *de facto* excluded? In a word, on what grounds can prehistory in general and British prehistory in particular claim to be a science?

Is prehistory experimental? Yes, but only within very narrow limits and in a restricted sense. Normally only one sort of experiment is open to the archæologist, an experiment that can never be repeated—I mean excavation. Or does prehistory work? Can it formulate general rules that serve as guides to successful action? Yes, but only as to how to acquire fresh knowledge.

The prehistorian's aim is to reduce to an ordered and intelligible system the scattered and isolated splinters of evidence collected through surveys, excavations, and chance discoveries. But only a few regions and short periods have as yet been so thoroughly explored and investigated that the facts of themselves make an intelligible pattern. We have to fill up the gaps with guesses and assumptions.

The title of my address is intended to recall an assumption which has exercised a profound formative influence on archæological studies, which is indeed held by many as an axiom above discussion. In 1899 Montelius stated this faith in the book, entitled, like my address, "The Orient and Europe". "At a time when the peoples of Europe were so to speak without any civilization whatsoever, the Orient and particularly the Euphrates region and the Nile valley were already in enjoyment of a flourishing culture. The civilization which gradually dawned on our continent was for long only a pale reflection of Oriental culture."

In 1899 such a statement was very much more an affirmation of faith than a deduction from accumulated data.

Restated in simpler, but still not altogether unambiguous terms, the statement quoted from Montelius resolves itself into the following propositions, treated as axioms: (1) Civilization in the Orient is extremely ancient; (2) civilization can be diffused; (3) elements of civilization were in fact diffused from the Orient to Europe; (4) the diffusion of historically dated Oriental types provides a basis for bringing prehistoric Europe within the framework of historical chronology; (5) prehistoric European cultures are poorer than contemporary Oriental cultures, that is, civilization is later in Europe than in the East. To-day, none of these propositions except No. 2 need be treated as "postulates rather than as conclusions from the results of investigations"; for the excavations published during the last five years have provided abundant data by which to test the axioms' validity.

Let me first summarize the results of excavations in Hither Asia that tend to establish the first axiom—the antiquity of Oriental culture. The beginning of the historical or Dynastic period in Egypt and Sumer now constitutes a fairly accurately dated horizon. The coincidence of Egyptian and Mesopotamian sources is now close enough to permit of this horizon being dated with general consent about 3100 ± 100 B.C. The latest additions to knowledge resulting from Frankfort's masterly operations at Tel Agrab, Tel Asmer and Khafaje intensify our appreciation of the high level of Oriental civilization and emphasize the long duration of the Early Dynastic Age. The Sin Temple at Khafaje was rebuilt five times. In the same period the Temple of Abu at Tel Asmer underwent four reconstructions.

The Early Dynastic period itself was far from the beginning of urban life. In the Tigris-Euphrates delta it is preceded by two periods, termed respectively the Jemdet Nasr and Uruk phases, during which monumental buildings were already being erected. At Erech below the earliest Dynastic temple ruins, the German excavators uncovered the wall stumps of a gigantic edifice that had been reconstructed once or twice in the Jemdet Nasr period. These walls in turn rested on ruins of a no less imposing building, the Red Temple—a veritable cathedral adorned with a mosaic of clay nails and with friezes of stucco beasts. The Red Temple itself was twice remodelled and was after all only the successor of a still earlier, but no less monumental, cathedral, termed in view of its unusual stone foundations the Limestone Temple. Now you do not build a

* From the presidential address to Section H (Anthropology) of the British Association, delivered at Cambridge on August 22.

cathedral every fifty years, even if it be built only of mud brick. This series of three prehistoric temples with their several reconstructions must cover a period of several centuries.

But even in the Limestone Temple we are dealing with a highly organized urban civilization presupposing centuries of experimentation and development. Some aspects of that development are explicitly revealed in the archæological record. From the floor level of the Limestone Temple the Germans sank a shaft 17 m. or just under 60 ft. deep to virgin soil. It was dug entirely through the debris of prehistoric dwellings. As one winds down the ramp into that dizzy abyss one can distinguish in the pit wall eighteen layers marked by hearths, floors, stumps of walls, and heaps of sherds and artefacts. Admitting that I am now guessing perhaps rashly, I cannot believe that the al'Ubaid culture represented in the lower levels at Erech is later than 4500 B.C.

It has never been suggested that the geologically very recent delta of Lower Mesopotamia was the cradle of food-production. It is in fact evident that the al'Ubaid farmers who settled on the freshly emerged land-surface there brought with them from older regions a culture already mature. In the last five years the excavations of Mallowan and Speiser in Assyria and Syria have given us glimpses of what preceded al'Ubaid in the Fertile Crescent. It is true that history does not fully dawn there until relatively late—until the time of the Dynasty of Akkad indeed. But relations with Lower Mesopotamia were so close and so continuous that the archæological record provided by the prehistoric levels of Gawra, Nineveh, and Chagar Bazar can be proved parallel to that from the protohistoric levels of Sumer. So when we find in Gawra XIII pottery and other relics typical of the earliest or al'Ubaid phase of Sumer's prehistory, we have no reason to doubt that al'Ubaid in Assyria is virtually contemporary with al'Ubaid in Sumer. But Gawra XIII already boasted a cluster of three handsome and monumental temples, decorated with painted buttresses and niches, and grouped round a court 20 m. by 14 m. in area.

The al'Ubaid temples at Gawra are perched upon a tell, formed from the ruins of older settlements, and rising already 25 m. to 30 m. above the plain. Below the al'Ubaid foundations come settlements belonging to the Tel Halaf culture. Mallowan found the same culture beneath, and therefore older than, al'Ubaid remains at Arpachiya, 38 ft. below the historical horizon at Nineveh and in deep layers at Chagar Bazar. The Tel Halaf culture is accordingly older than the al'Ubaid—if you want a guess, I would hazard 5000 B.C. as a moderate date—but it is no less sophisticated. Monumental circular buildings, cobbled streets, delicate and beautifully painted vases, ingeniously carved stone beads and stamps already used for sealing property attest already a well-organized society, an advanced economy, highly developed craftsmanship.

The Tel Halaf culture must have flourished for several generations. Mallowan uncovered at least five building levels at Arpachiya and seven at Chagar Bazar; and yet at Gawra, Nineveh and Chagar Bazar the oldest Tel Halaf foundations rest upon the ruins of villages characterized by painted pottery of the Samarra style. Guessing frankly once more, these might take us well back into the sixth millenium B.C.

Yet the culture revealed even in these remote depths resembles the European neolithic only in the most formal sense—in the continued use of polished stone adzes and some other tools. The earliest cultures of the Fertile Crescent, like its Early Dynastic cities, are so unlike anything we know in Cis-alpine Europe before Roman times, are economically so far ahead of Köln-Lindethal or Skara Brae or even Tószeg as to seem almost incommensurable. Yet some comparison is inevitable if Montelius's fifth postulate is to be objectively criticized.

The abruptness of the contrast may to-day be softened by reference to a region that is more than spatially intermediate between Mesopotamia and Europe.

The results of the long campaign conducted at Alişar Hüyük by the Oriental Institute of Chicago, which were published this year, have given the first definite clue to the culture-sequence on the plateau. In particular, they provide the skeleton of a chronology.

Below the Hittite foundations on the acropolis at Alişar (but not on the terrace) came a deposit with Cappadocian painted ware now termed Early Bronze Age or Alişar C. Below that, five building layers, accounting for 11 m. of deposit, represent the Copper Age or Alişar B. This must end by 2000 B.C. A beginning towards 3000 B.C. might be inferred from an imported Mesopotamian cylinder of Jemdet Nasr style, stone figurines like those regarded as Anatolian intruders in the Early Dynastic layers of Gawra and Tel Asmer, and animal pendants of stone remarkably like those from the Early Dynastic temple of Sin at Khafaje. To this same Copper Age belong the ruins and burials at Ahlatlibel near Ankara. It was a period when commerce was sufficiently organized for metal to be common and seals to be useful.

But beneath the lowest Copper Age floors, von der Osten's shaft pierced 8·5 m. of debris, divisible into seven building levels, before reaching virgin soil. The earliest Anatolian culture, represented

by Alişar A, is already so advanced that it is accurately termed Chalcolithic. However sparingly used, copper, silver and lead were common enough to indicate well-established commercial channels of distribution and specialized producers. Stamp-seals were already employed. But certain pot-forms and fabrics are already comparable to the Central European; two-handled tankards, like those of the Hungarian Copper Age, occur in the topmost layers only (Alişar A2); for the rest, lugs take the place of handles, but a distinctive shape is a high-pedestalled bowl, at first with a remarkably Danubian profile. The fabric is self-coloured, black to red, but generally muddy and sometimes parti-coloured—black inside and round the rim, but brownish below on the exterior. The Anatolian Chalcolithic seems rooted in the fourth millennium B.C., but how far back remains quite uncertain.

Despite conspicuous divergences, the Copper Age and Chalcolithic cultures of Central Anatolia are patently related to, and continuous with, those of north-western Anatolia, long known from Schliemann's excavations at Troy. Re-excavation there under Blegen has substantially enhanced the impression of the antiquity of Anatolian culture. If the Americans have not yet provided unimpeachable data for determining the absolute age of the earlier 'cities', they have at least filled in and expanded the scheme propounded by Schliemann and Dörpfeld. The Troy that the Achaeans might have sacked about 1200 B.C., did Lord Raglan allow us to believe in a Trojan War, was not VI but VIIa. Troy VI goes back on the strength of Helladic imports to 1500 B.C. Cities V, IV and III turn out to be quite important settlements, divisible into several architectural levels, and making up together a formidable accumulation 4 m. deep. Troy II, thus separated from the Mycenaean horizon, can no longer be brought down to the Shaft Grave epoch, however neat Åberg's typological comparisons may look. It is firmly anchored in the third millennium, whatever its precise limits may be. Troy I below it was already a city, girt by an imposing wall. Its citizens were executing monumental sculptures that provide a new limiting date, on Montelius's assumption, for the statue-menhirs of Atlantic Europe. By this time, as Miss Lamb has shown at the contemporary Lesbian township of Thermi, copper and even bronze were already being worked, celts might have hammered flanges, battle-axes were used in war, while trade brought marble vases from the Ægean Islands. Remains of a still earlier phase of culture may be discerned at Kum Tepe. Soundings there produced pedestalled bowls like those from the earliest Chalcolithic of Alişar that seem still missing in Troy I and the contemporary Lesbian site.

The experiments in Anatolia thus go far to re-enforce with objective facts the antiquity and relatively high level of Oriental culture assumed in axiom 1. Moreover, taken in conjunction with Heurtley's excavations in Macedonia, they concretely demonstrate connexions between Asia and Europe that are the precondition for admitting axiom 3, and provide a crucial instance for testing axiom 5, that is, for comparing demonstrably contemporary cultures in Europe and Asia. Heurtley has convincingly demonstrated the Anatolian ancestry of the Early Macedonian Bronze Age culture; it begins with fully developed horned tubular lugs growing from the bowls' rims. The evolution of this odd type that appears fully formed in Europe can be traced stratigraphically on the Asiatic side. It emerges as a finished product first in phase B at Thermi; its earlier stages are illustrated in phase A. For once we have, fully documented a cultural spread which is irreversible; in this concrete instance axiom 3 becomes a conclusion from ascertained facts.

Implanted in Europe, Anatolian culture appears poorer than its Asiatic parents. Even in phase A, Thermi was quite a township, the contemporary Troy I a fenced city. Their economy was so far advanced that copper and even bronze could be used for tools as well as weapons; metal was so plentiful that quite a lot was left lying about for Miss Lamb to find. The Early Macedonian settlements which are not older than Troy I give the impression of rustic villages. For all the metal collected among their ruins, they might be neolithic. Macedonia was still veiled in mists which the Oriental sun must pierce before an economic system comparable even to the Anatolian could function.

But if the Early Bronze Age culture of Macedonia is unambiguously rooted in Asia, the later neolithic culture which it supersedes is no less securely linked with that of Vinča and Tordos in the Middle Danube basin beyond the Balkan ranges. Comparison of the Macedonian relics with those from the Morava-Middle Danube-Maros sites shows that we are dealing not with two cultures, but with different facies of one and the same culture. We may reasonably speak of a Vardar-Morava culture extending from the coasts to the Maros.

How such a continuum was constituted remains a question for debate elsewhere. Its absolute antiquity cannot be defined with precision. For our purpose the supreme importance of the Vardar. Morava complex is that it establishes at least once a continuity of culture from the Ægean to the Danube basin. Whatever be the chronological horizon of that continuity, its existence provides a justification for admitting axiom 3—diffusion from Asia to Central Europe is likely.

(To be continued.)

Soil Erosion in India*

By Dr. R. Maclagan Gorrie

CONTRASTS WITH AMERICAN DATA

EROSION losses are less where the rainfall is well distributed, and it is now commonly recognized that erosion has most serious consequences in arid tracts. A heavy monsoon has more effect upon sloping fields than it has on neighbouring grasslands, whereas in arid climates the smaller area of fields is more carefully terraced, but the neighbouring grazing grounds are more vulnerable to infrequent but heavy downpours. This may serve to explain an anomaly that occurs in run-off intensity data. American figures worked out by Ramser and frequently quoted show the following averages in cubic feet per second per square mile, and in contrast I also quote tentative data of the same sort for Indian conditions.

RUN-OFF IN CUBIC FEET PER SECOND PER SQUARE MILE*.

AMERICA.	Cusecs	PUNJAB.	Cusecs
Hilly timber, 10–30% slope	300	Terraced rice fields ..	50
,, pasture	620	Foothills afforested and with soil-catching small dams	120
,, cultivated ..	1040	Foothills scrub forest closed to grazing ..	700
		,, open to grazing ..	1100
		,, disforested and heavily grazed ..	1600

* Cf. *Current Science*, August 1937, author's review of Q. C. Ayres' "Soil Erosion".

The American farmer using a motor-tractor keeps his fields large, and so the run-off from broad slopes of bare plough land is greater than from his paddocks of comparatively well clothed pastures. This also applies to Canadian and Australian average conditions and to parts of South Africa. On the other hand, the Indian peasant farmers have their fields in tiny and often well-terraced units which catch and hold the rainfall, whereas their grazing grounds are so misused and so badly protected with a mutilated plant cover that the run-off from them is far heavier. In the African dependencies, according to Sir Frank Stockdale's statement at a meeting of colonial officers held in Oxford in June 1937, "agricultural activity was as frequently to blame for erosion as overstocking with live-stock", so probably their run-off figures would be equally heavy for cropped land as for grazed land. Reliable data for run-off and erosion, and also for rainfall intensities and storm behaviour, are lamentably scarce even for our most important catchments, and a great field of work awaits the next generation of colonial research workers.

* Substance of a paper read before the Royal Society of Arts on May 3.

RAINFALL AND RIVER BEHAVIOUR

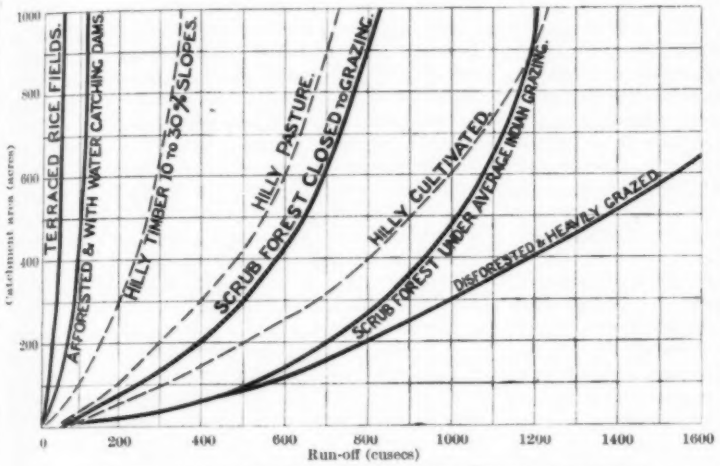
Mr. E. G. Bilham's paper on "Weather and Water Supply" read at the Public Works Congress, 1937, directs attention to the fact that even in Great Britain very few attempts have so far been made to correlate the loss of rainfall by evaporation, surface run-off, and seepage with the behaviour of streams. More work is required upon the actual fate of all the rain that falls upon a given type of plant cover and the contribution which this cover makes to the nearest stream in terms of surface and ground-water flow, before we can discuss intelligently the reactions of the larger rivers.

A study of the Ravi River flow records for the last twenty-five years carried out by the staff of the Punjab Irrigation Research Institute shows no significant indication of any gradual increase in number or intensity of floods nor any direct correlation of heavy floods with heavy rain. This is presumably owing to the fact that the heaviest floods arise from heavy snow-melt in the high inner hills, combining with a series of downpours falling on eroded ground in the foothills. The figures of winter flow do, however, indicate a continued deterioration in supplies available for winter irrigation. It is scarcely to be expected that a simple phenomenon such as the run-off of rain can be correlated exactly with the highly complex phenomena which go to make up the stream-flow of a large river. The Ravi River's catchment of nearly 15,000 square miles varies from 2,000 ft. to 20,000 ft. in altitude and contains several recognizable meteorological zones, so instead of looking for any correlation between rainfall and run-off for the whole, it would be better to study small individual sections and find out how each tributary reacts to the rain and snow which fall within its catchment. Unfortunately, the rainfall data in this case are for only one rain gauge for the 15,000 square miles!

NEW INDIAN STATISTICS OF EROSION LOSSES

Reliable run-off figures for forest and grassland are now available for the first time for Indian conditions. A technique of volumetric analysis of water and silt was worked out by the Punjab Irrigation Research staff at Madhopur in 1936 for a type of small isolated plot of undisturbed soil 3½ sq. ft. in area, and this method has since been followed in forest plots at Nurpur in Kangra district. A battery of six plots gave three pairs, namely, (i) grass, (ii) grass and shrubs, and (iii)

bare soil, on a slope of 1 in 4 on an eroded hillside of poor Siwalik sandstone. The grass cover over all is distinctly poor, as it is recovering slowly from previous heavy grazing. The bare plots contain a little grass which has been kept clipped back with scissors. They thus simulate local grazing conditions to some extent, though we have not reproduced the destructive trampling action of cattle scrambling on a greasy hill-side; and the run-off from grazed areas must therefore be considerably heavier than the figures now reported.



COMPARATIVE RUN-OFF FOR AMERICAN AND PUNJAB CONDITIONS.

American data from C. E. Ramser's curves (broken lines). Indian data from Pabbi Hills torrent measurements by Irrigation Branch (full lines).

The results of the first monsoon's catch is as follows:

PERCENTAGE OF RAIN WHICH RAN OFF:	Grass 80% cover	Grass and shrubs 90% cover	Bare soil, grass clipped every 3 days
Out of total of 46 in. on 32 wet days during July–October 1937 ..	7	5	25
Out of total of 5¼ in. in 4 hours, the heaviest single storm	2·2	1·7	6
WEIGHT OF SOIL LOST PER ACRE:			
Carried away on 32 wet days ..	3,500 lb.	3,900 lb.	18,500 lb.
Carried away by a single storm (5¼ in. rain)	260 lb.	307 lb.	3,511 lb.

These figures give one food for thought when it is realized that *in a single storm the uncovered plots lost soil at the rate of 1½ tons per acre*. This may be taken as a typical figure for all bare fallow fields in the foot-hills of northern India except properly levelled rice land, and they are definitely conservative for the average village grazing lands which suffer from trampling of cattle. The ordinary grazing lands also suffer from the accumulative action of shallow gullies cutting the surface on long slopes, a phase of erosion which is, of course, not reproduced in our small square plots.

Measurements reported from the Bombay Dry Farming Research Station at Sholapur (chief investigator, Mr. N. V. Kanitkar) show a loss of 115 tons of soil per acre per annum from a field of *jowar*, a *Sorghum* which is the most important combined grain and fodder crop in the Bombay Deccan. This loss was caused in a properly cultivated plot as a result of two very intense storms of 3·5 in. and 4·3 in. The total rainfall of 28 inches is usually fairly well distributed and no such intense storms occurred during the previous year when measurements were started. The silt lost in these intense storms was particularly rich in valuable plant foods such as lime and potash, which were stolen by erosion, leaving the remaining soil much poorer. Of the various other kinds of plant cover tested, the amount of water lost in the run-off was not strikingly different where weed or crop cover was dense. The amount of soil lost where the weeds had been reserved in fallow was just one two-hundredths of the *jowar* plot, while the clean fallow of bare but uncultivated ground yielded 25 tons of soil per acre or 22 per cent of the *jowar* plot's loss. These astonishingly heavy losses of silt were from very gently sloping ground, the average slope being 1¼ per cent or 1 in 80, and the data are entirely reliable, having been collected from thoroughly isolated plots. I am indebted to Mr. Kanitkar and Dr. W. Burns for permission to use these figures.

The point which this experiment has brought out is that, under Indian conditions, good cultivation on even a slight slope is no better than bad cultivation for saving soil, unless it is protected by some form of contour ridging. The only sure way of reducing soil losses during exceptionally heavy storms is by contour ridging which is sufficiently deep to render each field a more or less self-contained catchment unit, so that cumulative run-off from a series of fields is prevented. The necessity for such protection is brought out by subsequent figures for these same plots in 1937, so far unpublished but furnished in a letter from Mr. N. V. Kanitkar, who reports that this same *jowar* plot has lost a total in the year of 133 tons per acre. This included one storm in which 2·13 in. of rain in half an hour removed the huge amount of 52 tons of silt per acre.

Obituary Notices

Dr. Leo Frobenius

WE regret to record the death, at the age of sixty-five years, of Dr. Leo Frobenius, the widely known German anthropologist and explorer, which took place at Biganzolo on Lake Maggiore, Italy, on June 9.

The claim of Frobenius to be remembered in the annals of anthropology will rest on his intrepidity and assiduous devotion to exploration in African lands and among African peoples. In the course of his life he made no less than twelve journeys of exploration, all of a more or less arduous character, and it was on the last of these, when in 1934 he penetrated depths of the Sahara scarcely known to the Bedouin, and reached the sources of the River Ouwenat, that he contracted the malady which forced him to abandon the expedition and after some years of illness was the ultimate cause of his death.

Frobenius was born on June 29, 1873, in Berlin. At an early age he was attracted to the studies which became his life-work. After spending some years at the ethnological museums of Bremen, Leipzig and Basle, he determined to devote himself to exploration. In 1904 he founded the German Central African Research Expedition and embarked upon a journey to the Congo Basin, which lasted until 1906. In the following year he set out again, and between 1907 and 1915 completed six further journeys in Africa, visiting the Upper Niger, Timbuctoo, Togoland, the northern Sahara, the western Sudan, Khartoum and El-Obeid, Algeria and Tunisia, and finally Turkey and northern Abyssinia.

Henceforth for some years Frobenius was busily engaged in working up the anthropological material he had collected in Africa, and he published a number of important books and papers dealing with his observations and conclusions. He was a bold, original and independent thinker, but as he had shown in his earliest work as a young man, apt to generalize on insufficient evidence, as well as to give too wide an application to an interpretation which might be valid for a restricted area which had come under his observation. His theory of cultural continuity and cyclical development, in which he maintained that the various phases of civilization had developed in a manner exactly analogous to the growth of a living organism, was the subject of much embittered controversy.

In 1924 Frobenius founded the Frankfort Research Institute of Cultural Morphology, and four years later set out with seven assistants on an expedition to Central and South Africa, in the course of which he visited and conducted investigations among the Zimbabwe ruins of Rhodesia, shortly before the excavations by Miss G. Caton-Thompson, conducted under the ægis of the British Association, which was to visit South Africa in the following year. Frobenius found himself unable to accept the conclusion that these ruins were Bantu in origin, as suggested by Randall-MacIver in 1905, and as was confirmed by Miss Caton-Thompson's investigations, but arrived at the view that some six thousand years ago this area had been an outpost of Sumerian and Babylonian culture. He also concluded that the iron age had begun in Africa a thousand years earlier than in Europe, iron working having entered Africa from India by way of Madagascar. In the search of further evidence to support this conclusion, he afterwards visited India. Two later expeditions were to Tripoli in 1932, when he studied the prehistoric course of the Nile, and in 1934 to the Sahara, as already mentioned, his last journey. In this year he was appointed director of the Racial Museum at Frankfort, and for the rest of his life divided his time between Frankfort and his residence on Lake Maggiore.

Mr. W. R. Barclay, O.B.E.

WE regret to announce that Mr. William R. Barclay died at his home in Birmingham on September 16, aged sixty-three years. He was a leading metallurgist and one of the outstanding authorities on non-ferrous metallurgy.

Mr. Barclay was educated privately and later attended the Sheffield Technical College (now the University of Sheffield). During 1910–19, he was lecturer in electro-metallurgy in the University of Sheffield. During the Great War, he became chief metallurgist and assistant director in the Non-Ferrous Rolled Metal Section and technical director of the Electro-Metallurgical Committee of the Ministry of Munitions. He was made O.B.E. for his services.

In 1928, Mr. Barclay became managing director of Henry Wiggin and Co., Ltd., and in 1931 he was appointed consulting metallurgist to the Mond Nickel Co., Ltd. He was largely instrumental in initiating the company research and development organization, as a result of which, in conjunction later with the International Nickel Co., innumerable new uses were discovered for nickel and nickel alloys.

In 1936, Mr. Barclay was elected president of the Institute of Metals, and he was re-elected to serve a further term in 1937. It was during his presidency that the Institute decided to award an annual medal for outstanding services to non-ferrous metallurgy.

Mr. Barclay was well-known in metallurgical circles in the United States, and he was invited to deliver the Calvin W. Rice Lecture to the American Society of Mechanical Engineers in June of this year. At the same time, he was to be awarded the degree of doctor of science by the Stevens Institute of Technology. Unfortunately, owing to his illness, he was unable to attend these functions.

News and Views

Albrecht Penck

On September 25, Albrecht Penck, world-famed as geologist and geographer, will celebrate his eightieth birthday. Born at Renditz, near Leipzig, in 1858, Penck was educated at Leipzig and Munich, taking his Ph.D. in 1878. In 1885, two years after he had published his "Die Vergletscherung der Deutschen Alpen", he was appointed to the chair of geography in the University of Vienna, where he remained for twenty years, until in 1906 he was appointed to take charge of the Museum of Marine Studies in the University of Berlin. Under his direction, the Museum was much enlarged, and he himself made important contributions to the study of hydrography. In 1922 he was made director of the Institute of Geography of the University, becoming emeritus in 1927. While still at Vienna, Penck had established an international reputation for his illuminating treatment of geology and geography as linked studies. His "Morphology of the Earth's Surface" (1894) was speedily accorded recognition as a standard work. Notwithstanding his numerous contributions to geography, which his widely extended travels kept in close touch with practical realities, Penck's strongest claim to the remembrance of posterity will rest on his epoch-making studies of the Ice Age. Since the publication of "Die Alpen im Eiszeitalter" (1909), written in conjunction with his old pupil and friend, Ed. Brückner, his classification of the four phases of maximum glaciation has been fundamental in all studies of quaternary geology and the history and chronology of early man. In tendering our congratulations on this occasion to Prof. Penck, we hope that he may live to enjoy the homage due to his labours for some time to come.

Mr. H. C. Sampson, C.I.E.

Mr. H. C. Sampson is retiring from the post of economic botanist at the Royal Botanic Gardens, Kew, on September 30. Before going to Kew in 1927, Mr. Sampson had gained a wide experience of tropical agriculture in various parts of the Empire. Educated at the University of Edinburgh, he commenced his career in the Transvaal Department of Agriculture and in 1906 entered the Indian Agricultural Service, retiring in 1923 as director of agriculture, Madras. In 1920, Mr. Sampson made a tour in Cochin China and Cambodia, to study coco-nut and cotton cultivation, and after his retirement from India he worked for a time in Nyasaland for the Empire Cotton Growing Corporation. Mr. Sampson's appointment at Kew was made in connexion with the grant from the Empire Marketing Board for the promotion of the economic development of the Empire, and his work at Kew has been devoted to this end. In addition to giving advice on crop improvement and on the introduction of plants of economic importance to correspondents from all parts of the Empire, Mr. Sampson has paid visits, at the request of the Colonial Office, to British Guiana, British Honduras, the West Indian Colonies and East and West Africa, to study their economic resources. He has recently published a "List of the Cultivated Crop Plants of the British Empire" (*Kew Bull.*, Additional Series 12, 1936).

Sir Geoffrey Evans, C.I.E.

Mr. Sampson's successor as economic botanist is Sir Geoffrey Evans, who is retiring from the post of principal of the Imperial College of Tropical Agriculture, Trinidad. Sir Geoffrey was educated at Cambridge and was on the staff of the University Agricultural Department before entering the Indian Agricultural Service in 1906. He retired in 1923 as director of agriculture, Bengal. Afterwards, Sir Geoffrey worked in Australia, Fiji and New Guinea as director of cotton culture under the Empire Cotton Growing Corporation and was appointed principal of the College in Trinidad in 1927.

Mr. O. T. Faulkner, C.M.G.

The governing body of the Imperial College of Tropical Agriculture, Trinidad, has appointed Mr. O. T. Faulkner to the post of principal of that College in succession to Sir Geoffrey Evans. It is difficult to suggest the name of anyone better qualified to fill this appointment. Mr. Faulkner has had a ripe and varied experience of tropical and subtropical agriculture in its many and varied phases. He first saw service abroad as mycologist to the Rubber Growers Research Association in Malaya, and after working there for two years was in 1914 appointed to the Indian Agricultural Service as deputy director of agriculture in the Punjab. In 1921 he resigned from this Service to take up the appointment of director of agriculture, Nigeria. For his valuable work in this capacity, where he defined the agricultural policy of the country and built up a most efficient Department, he was made C.M.G. in 1928. In 1936 he was transferred to Malaya as adviser on agriculture, which post he now relinquishes to become principal of the Imperial College of Tropical Agriculture. As this College is responsible for the training of all recruits for the Colonial Agricultural Service, the post of principal is a most responsible and important one. Mr. Faulkner was born in 1890 and took his Natural Sciences Tripos at Cambridge in 1911 with first-class honours, and in the following year took his diploma in agriculture.

Scientific Theory and Publicity

The strictures on the methods of the B.B.C. in relation to certain broadcasts dealing with archæological subjects, with which Prof. Gordon Childe prefaced his presidential address to the Anthropological Section at the Cambridge meeting of the

British Association, has once more raised a perennial problem in scientific discussion, which is of no little public interest. The methods of the B.B.C. must be above the suspicion of propagating error, especially in relation to the advance of scientific discovery. Unfortunately, the field of research to which Prof. Childe refers has been in the past the happy hunting ground of the irresponsible theorist. In certain branches of archæological investigation the apparent familiarity of the terminology and subject-matter—the character and purpose of objects of everyday use in the life of the past, and the inferences as to cultural and racial contact to be drawn from them—not only lend themselves to speculation, but also the more startling and sensational the exposition, the more readily it commends itself as matter likely to be of interest to the public, to those who control the machinery of publicity, the lay Press and organizations, of which the B.B.C. is the most important, engaged in the unofficial education of the public. The obvious remedy that the B.B.C. should be advised by a committee of scientific men, and that other organizations and the lay Press should consult expert opinion in order to eliminate the danger of error, is open to the imputation of stifling progress in favour of orthodoxy. The only remedy is full and free discussion without favour, after an impartial statement of controversial points at issue.

Jupiter's Satellites

POSITIONS of the newly discovered Satellite x are available from July 6 to August 1, but the interval is too short for the computation of an orbit with any degree of certainty. A preliminary investigation, however, suggests that the object is at a distance of about 7 million miles from Jupiter, its motion being direct. Whether it is just inside the orbit of VI or outside that of VII is open to doubt, but further observations will enable computers to decide this point. Observations of Satellite XI are available from July 30 to August 1, but it is impossible to compute an orbit from such data. From the figures it is conjectured that the body cannot be less than 10 million miles from Jupiter, and so it certainly lies outside VII, but there is nothing at present to show that it does not lie outside IX.

THESE preliminary investigations were made by Dr. M. Davidson, who assumed, in the computation of the orbit of Satellite x, that this was practically circular. While going to press a Harvard Card announces that two different orbits for Satellite x have been computed, the results of which have been communicated by Prof. E. I. Yowell, Cincinnati Observatory. The figures in round numbers are as follows: The first orbit, which indicates that the motion of the satellite is direct, has a very high eccentricity, 0·6362, the semi-major axis being 5,900,000 miles. This implies that the satellite makes its closest approach to its primary at a distance of 2,150,000 miles, its greatest distance being 9,650,000 miles. The other orbit shows an eccentricity 0·6207, motion retrograde, and the semi-major axis 18,310,000 miles. If this be correct, the satellite would approach Jupiter to a distance of 6,945,000 miles, and would recede to 29,675,000 miles, the time to complete a revolution being more than $2\frac{3}{4}$ years. The fact that two such diverse orbits can be deduced from the same data shows the great difficulty, as already pointed out, of attaching much importance to the elements which are based upon a short time interval.

Inland Ice Field in Alaska

A BULLETIN of the National Geographic Society of America announces that an expedition, under the auspices of Harvard University and of the National Geographic Society, and under the leadership of Mr. Bradford Washburn, has made, during the course of aeroplane flights, the important discovery of a vast inland ice field in Alaska. The ice is hemmed in by a coastal range of mountains with peaks reaching 10,000–19,000 ft. above sea-level. This range stretches from the Copper River Valley above Cordova to the Alsek River Valley in the Yukon. Most of the ice lies athwart and to the west of the Alaska–Canada boundary line, where it turns north to the Arctic Ocean. The ice thus forms a barrier to land communication between the south "panhandle" of Alaska and the major part of the territory in the north. It is stated that the ice field covers a stretch of territory 235 miles long. It is in effect so extensive as to constitute an ice reservoir which provides the source of large outflowing glaciers, including the Bering and Malaspina glaciers, the immense size of which—they are 30 and 50 miles wide respectively—is now accounted for. This part of Alaska (which possesses the conditions favourable to glacier formation—namely, high altitude, low temperature and high precipitation) thus contains the largest known ice fields outside the polar regions. It is a remarkable feat that an expedition of only four men should have succeeded in photographing 1,500 square miles of territory in a country peculiarly difficult of access. They have also carried out geological work in the St. Elias Range.

Solar Activity and Radio Communication

IN the speech made by the Postmaster-General, Major Tryon, at a luncheon of the Newcastle-on-Tyne Chamber of Commerce, he announced that the Post Office, after consultations with the American telephone authorities, is constructing a special radio-receiving station to combat the intense sunspot activity which is expected to interfere seriously with world-radio communications in 1940. The long-distance international radio-telephone services are mainly operated on short wave-lengths, and are found to be particularly susceptible to serious interference at periods of great sunspot activity. This has been proved by the graphs at short-wave reception stations, and the connexion between solar flares causing sunspots and fade-outs and magnetic disturbances has been clearly established. Approximately, they appear to follow an eleven-year cycle, a disturbance being due in 1940, and owing to the enormous

increase in the long-distance telephone traffic, engineers are doing their utmost to prevent disorganization of the traffic at that period.

THE British Post Office and the American telephone authorities have decided that the best way to obviate the effects of 'sunspot' activity is to adopt a new technique for the reception of short-wave transmissions. A number of receiving aerials will be suitably spaced in the direction of the incoming signals. The Post Office has issued a statement giving an ideal reception station. It would accommodate six receivers for twelve circuits and sixteen separate aerials erected so as to face America. Very stringent conditions are laid down for an ideal site for the station. It must be at least two miles long, a quarter of a mile broad, the length being in the direction of America. It must be flat and reasonably damp. It should be remote from roads carrying motor traffic and yet be a reasonable distance from London to keep the cost of the land lines low. The present Post Office receiving station at Baldock does not even approximately satisfy these conditions. The Cooling Marsh at Rochester nearly fulfilled the required conditions and this has been selected. It is expected that the new station will be in use early next year, and that even under very bad conditions it will be possible to maintain a satisfactory commercial telephone service.

New Metallurgical Laboratories at Sheffield

SIR WILLIAM BRAGG opened the new Sir Robert Hadfield Metallurgical Laboratories at the University of Sheffield on September 15. The laboratories mark the first stage in a scheme of development of the University for which an appeal was issued two years ago. Sir Robert Hadfield contributed generously in response to the appeal, and as a mark of appreciation of this and his many other benefactions to the University, and particularly the Department of Metallurgy, the laboratories have been named after him, and a commemorative plaque in the main laboratory was unveiled by Sir William Bragg. The following telegram was sent to Sir Robert Hadfield: "Members of the University and others assembled at the inauguration of the Sir Robert Hadfield Metallurgical Laboratories send you hearty greetings. They remember with gratitude your continuous generosity to the University, and regret your absence from this ceremony. They send you best wishes for a speedy recovery to health." The University of Sheffield is unique among the universities of Great Britain in that it confers degrees in metallurgy as distinct from degrees in science; these were established so long ago as 1907. The new laboratories will be used primarily for teaching, but research work will also be carried out. In his address, Sir William Bragg referred to the relation of science to industry, and said that although they may be forced together by circumstances, a metallurgical school, like the restraining constituent in an alloy which prevents separation of the components, holds theory and practice together and gives the industry strength and adaptability.

International War on Locusts

THE Fifth International Locust Conference held at Brussels at the end of August was attended by delegates from more than twenty countries. The great economic importance of the problem was emphasized by the results of a statistical inquiry organized by the International Centre for Anti-Locust Research in London. The information collected from the majority of the countries suffering from locusts and grasshoppers showed that the average cost of these pests to the world amounts to not less than 15 million pounds per annum. Discussions at the Conference were centred mainly round the necessity of establishing permanent organizations for the supervision of the original centres of locust outbreaks, with a view to the prevention of such outbreaks in future. An agreement was reached by the various delegations that such organizations should be established without delay and financed on an international basis. This decision was made possible by the extensive investigations carried out during recent years by an international team of entomologists surveying some of the most inaccessible parts of Africa and Arabia. There is every hope that the recommendations made by the Conference will be adopted and acted upon by the Governments concerned, and that the control of locusts by the prevention of the swarm formation will become an accomplished fact.

Launch of the *Graf Zeppelin*

A NOTABLE example of the progress of aeronautical science was provided by the launching on September 14 of the new German airship L.Z. 130, to which Dr. Hugo Eckener gave the name *Graf Zeppelin*. The launch is described as having been carried out with precision and the great ship took to the air perfectly. It will be recalled that, on a similar occasion two years ago, the *Hindenburg* took about half an hour to rise and then twice lurched downwards before her height was brought under control. It may therefore be inferred that the designers and constructors have now at their disposal much more complete knowledge as to the factors which influence the stability and behaviour of large airships and that the new vessel is thereby the more assured of a successful career. On the first of her acceptance trial flights she cruised for a period of eight hours and made a good landing at the Loewenstadt Military Aerodrome. Hydrogen was used as the lifting medium. When the *Hindenburg* was wrecked at Lakehurst in the United States, it was stated that hydrogen would not in future be used. As, however, helium is practically unobtainable outside America, the engineers have devised a method whereby it is claimed that the main risk is largely eliminated. This is associated with the necessity for releasing free hydrogen as the load diminishes due to the consumption of the fuel, but by arranging for the storage of the water formed during combustion, they have provided the necessary ballast so that the ship's height can be controlled with little or no recourse to wastage of hydrogen. The motive power is supplied by four Daimler-Benz engines, each of more than

700 horse-power, which give the ship a cruising speed of about 80 m.p.h. In length she is 803 ft.—slightly less than the *Hindenburg*—but her hydrogen capacity of 7,062,000 cub. ft. is fully 25 per cent greater.

Iron Age Settlements in Wiltshire

THE investigations by the Prehistoric Society of iron age sites near Salisbury have completed for the time being the examination of the settlement at Odstock, which began on June 12 under the direction of Mr. C. W. Phillips, honorary secretary of the Society. About half of the six-acre site has been dug; and the remainder will be examined next year. The settlement is dated at about 200 B.C., and, as anticipated, was found to have been occupied by a small agricultural community, growing wheat, oats, barley, peas and beans, though traces of wheat only have been discovered. Apparently they farmed on an extensive scale. As much as fifty tons of grain was stored in a single season. Light is thrown on their methods in the report of the recent investigation (*The Times*, Sept. 6). Many pits for the bulk storage of grain were found within the settlement enclosure, but as storage in damp conditions would encourage the grain to sprout, it was first toasted in large ovens before being placed in the pits. Remains of ovens used for ordinary cookery have also been found, as well as quantities of pottery, iron knives, bone implements, etc. There is evidence that among the domestic animals were pigs, cows and goats, and a large number of horses of a small type. Some time after the first occupation, the settlement was surrounded by an enclosing bank and ditch, which were in no sense a fortification. Within this enclosure, in addition to the pits already mentioned, were a large house, a timber structure forty-five feet in diameter with an external veranda, a second, which was thirty feet in diameter, and a number of other timbered erections.

IF the inference as to the character and purpose of the fragments of pottery from the pits is well founded, and they are the remains of ovens which had been used for drying corn, this is the earliest link in a chain of evidence for a practice which can then be traced in Britain from about 200 B.C. down to modern times. In *Antiquity* of September, Dr. Cecil Curwen refers to the practice of drying corn in kilns in the island of Lewis, comparing the kilns with the corn-drying furnaces found in some Romano-British settlements in southern Britain. Mr. O. G. S. Crawford in a note quotes evidence for the practice in the west back to at least the sixth century of our era; while Dr. Curwen, adding that the kilns seem to have been a product of Roman culture in western Europe, states that, so far as he was then aware, they did not occur in Britain before the latter part of the Roman period. The evidence from the Wiltshire settlement is thus of considerable interest as a possible instance, considerably earlier in date and not of Roman origin, of a practice with a prolonged history of cultural continuity.

Prehistoric Scottish 'Temple'

FURTHER progress is reported in the excavation of the prehistoric 'temple' at Clydebank, Dumbartonshire, of which Mr. Ludovic Mann is in charge. The central area of the site, in which are a large number of inhumed and cremated interments of the stone and bronze ages, is estimated to have a diameter of six hundred feet. A recent discovery, reported in *The Times* of September 19, is that of the remains of a circular walled enclosure, 43 feet in diameter, at a distance of 219½ ft. from the main centre, which is now in course of being uncovered. In the walling to the north-west has been found a large rectangular stone. In contact with this was a fallen pillar-stone. This seems to have formed part of an altar-like structure. The pillar-stone had been shaped, and on cleaning showed traces of what are described as serpentine devices in black and red pigments—a discovery which, if confirmed by further examination, appears to be unique in British archæology. At a distance of 55 ft. from the centre of this stone ring, and on the same radius as the stone and pillar, was another large fallen upright stone. Many of the finds on this site, which include five different types of pottery, are said to be unique in character and technique. A large number of socket holes have been discovered, which contain decayed and carbonized wood, apparently largely of oak. The 'temple' seems to have consisted to a great extent of earthworks, of which the layout is indicated by the postholes along the margins. Traces of a circle of nineteen large equidistantly set monoliths have been detected at a distance of 129 ft. radius from the main centre. It is evident that this site is of considerable importance and complexity, and that careful excavation and planning will be necessary before its true character and purpose can be determined.

Economic Use of Water-Power

UNTIL recently, engineers considered that when both water- and fuel-power were available, then it was best to develop all the water-power first and then use steam as an auxiliary source of power. In designing many recent power stations this procedure has almost been reversed. The steam station is built first, the overhead costs being much cheaper; then when the load gets large and it would otherwise be necessary to provide reserve generators and equipment to take the main load, a beginning is made with the water-power station, which is mainly used to help with the peak load, and so avoids the necessity of purchasing reserve generators. In the preliminary report published in 1934 of the National Resources Board, set up by the United States Government, it is stated that "the great technical advantage of water-power plants is that they can be turned on for a few hours' work and then turned off again without much loss". In the present technical regime, their function is mainly that of a supplementary source, used to carry peak loads for brief periods. During the rest of the time the load is carried by the more economical fuel burners. In the August number of the *BEAMA* journal, H. E. M. Kensit points out that quite small water-power stations possessing good

'pondage' or moderate storage facilities can be economically developed to several times their continuous capacity in order to take the peak loads of fuel power systems. In Great Britain the Water Power Sources Committee reported in 1921 that there were 250,000 kilowatts of continuous power available. The modern view is that where small water-powers are used, they should be 'over-developed' by providing reservoirs so that they could take both the base loads and the peak loads. There are several electric-power schemes in America which take full advantage of the utility of the storage capacity of water-power in reservoirs when combined with steam stations.

Science and Culture

THE August issue of *Science and Culture*, published in Calcutta under the auspices of the Indian Science News Association as "a monthly journal of natural and cultural sciences", includes several important contributions and is in every way a credit to all who are concerned with its production. In the leading article on social implications of science, support is given for the movement represented by the committee on science and its social relationships of the International Council of Scientific Unions and the new Division of the British Association, and it is suggested that the Indian Science Congress Association should discuss the subject in a plenary session at the forthcoming meeting at Lahore. Sir James Jeans's lecture on the origin of the planets, delivered during the visit of delegates of the British Association to India, is published in the issue; and among the subjects of other interesting articles are: electrical charge distribution in thunderclouds, chemical composition and nutritive value of bananas, and recent advances in the study of plant growth hormones. The speeches made by Sir John Simon and Sir William Bragg at the anniversary dinner of the Royal Society on November 30, 1937, are reprinted in full from the *Notes and Records* of the Society, the first issue of which appeared in April last, together with notes on the foundation and history of the Society from the same publication.

The late Lord Rutherford

THE *Transactions and Proceedings of the Royal Society of New Zealand*, vol. 68, June 1938, contains an obituary notice and photograph of Lord Rutherford, signed "E. M.", doubtless the work of his old research student at Manchester, Dr. E. Marsden, who is now head of the N.Z. Department of Scientific and Industrial Research. There are about thirteen pages of biography written by one who well knew and admired Rutherford. Then follow nine pages of bibliography, listing about three hundred publications of books and papers by Lord Rutherford. This has been carefully compiled by Dr. C. M. Focken, Beverly-Mackenzie lecturer in physics at the University of Otago.

Earthquakes in Italy and in New Zealand

THE Central Office of Meteorology and Geophysics at Rome has recently issued its catalogue of *macrosismi*, or sensible earthquakes, for the year 1935 (*Boll. Sismico, anno* 1935). The total number known is 134, or about one third of the average number (412) for the forty years 1891–1930. Their intensity, also, was much less than usual; more than half were so slight that they were not able to shake doors or windows, and only one, with its origin in Etna, approached destructive strength, several houses in Acireale being slightly injured. The seismological section of the Dominion Observatory at Wellington has issued a somewhat less detailed report on the New Zealand earthquakes of 1936 (*Bulletin* No. 125; 1937). From this, we learn that the number of sensible earthquakes was 125, less than half the average (264) for the preceding twelve years, but nearly the same as the average number (122) for the eight years excluding 1929–32, in which many after-shocks of the great earthquakes of 1929 and 1931 occurred. Five of the shocks were of intensity 6 (Rossi-Forel scale), that is, none could be ranked as a destructive earthquake. The epicentral regions (Buller River and Hawkes Bay) of the two earthquakes referred to seem to have resumed their normal activity.

Renewed Seismic Activity in Greece

ATHENS has again been disturbed by strong earth tremors but no damage has been done in that city. The epicentre of the shock is reported to have been to the north-east of the city, and is probably the same as that of July 20 and also July 27. The most recent shock was registered on seismograms in London at about 3 a.m. on September 18, and does not appear to have been any more intense than that of July 20.

Belgian Red Cross Exhibition

THE Belgian Red Cross is organizing a popular scientific exhibition to be held in the Egmont Palace, Brussels, on October 1–30. It will be entitled "L'Homme" and will comprise the following groups: (1) movement (bones, muscles, nerves); (2) blood vessels and circulation; (3) respiration and voice; (4) foods and digestive organs; (5) thought and sensation; (6) special senses; (7) the part played by glands; (8) transparent organs; (9) the man of glass; (10) individual and public health. Further information can be obtained from Croix Rouge de Belgique, 80 rue de Livourne, Brussels.

A Catalogue of Rare Books

IN addition to works on English and European literature, the fine arts and a selection of important new books, a catalogue recently published by Bernard Quaritch, 11 Grafton Street, London, W.1, contains an annotated list of works on natural history including books from the library of Baron Bouck, early medicine and surgery from the library of Sion College, and the exact and applied sciences. Among the numerous works on natural history may be mentioned the German text of J. Hübner's "Collection of Exotic Butterflies" (1806–1841) described as "an extremely fine and complete copy of the greatest

entomological work ever produced," "Rippon's monograph on bird-wing butterflies (1898–1906), of which not more than thirty copies were completed, and Dresser and Sharpe's history of the birds of Europe (1871–1896). The most notable works on medicine and surgery in the catalogue are the first quarto edition of Sir Thomas Elyot's "Castel of Helth" (1541), the first edition of Gerard's "Herball or Generall Historie of Plantes" (1597) and the first edition of Harvey's "De Motu Cordis" (1628). Among the old works on the exact and applied sciences figure the first edition of Cocker's "Arithmetik" (1678), Billingsley's translation of Euclid's "Elements of Geometrie" (1570), Watson's translation of Bernard Palissy's "Learned Dialogue Concerning Waters and Fountaines" and Zahn's work on contemporary optics (1702).

Speed Records

ON September 15, the world's speed record on land was raised to 350·2 m.p.h. by Mr. John Cobb at the Bonneville Salt Flats, Utah. The car used was a 2,500 h.p. Napier-Railton. The previous record was 345·59 m.p.h. set up by Captain G. E. T. Eyston in his car *Thunderbolt* (see NATURE, Sept. 3, p. 430). On September 16, Captain Eyston regained the world record from Mr. Cobb with the *Thunderbolt*, attaining an average speed of 357·5 m.p.h. Sir Malcolm Campbell set up a water speed record of 130·91 m.p.h. on September 17 at Lake Hallwil, Switzerland, in his motor-boat *Bluebird*.

North-East Coast Institution Engineering Awards

THE Gold Medals of the North East-Coast Institution of Engineers and Shipbuilders given for papers read during the session have been awarded as follows: Engineering Gold Medal to G. J. Lugt, of the Werkspoor Company, Amsterdam, for his paper on "Diesel Varia"; Shipbuilding Gold Medal to Prof. F. Horn, of the Technische Hochschule, Berlin, for his paper on "Measurement of Wake"; M. C. James Gold Medal to Dr. T. Swinden for his paper on "Special Steels and their Application to Engineering and Shipbuilding". The Thomas Fenwick Reed Gold Medal, for the member of the Institution not more than thirty years of age who, among entrants for the medal, shows the greatest evidence of ability to take a share in the control of industry, has been awarded to John Hindmarsh. Mr. Hindmarsh was for some time in the employment of Michell Bearings, Ltd., before obtaining his Whitworth Scholarship, when he went to King's College, London; he is now employed by Messrs. Swan, Hunter and Wigham Richardson, Ltd., Neptune Works, Walker, Newcastle-on-Tyne. The Institution is giving two new scholarships this session (each of £100). These have been awarded to Harry Chilton, an apprentice of the North-Eastern Marine Engineering Co. (1938), Ltd., and a student at Sunderland Technical College; and Thomas Corin, an apprentice ship draughtsman in the employment of Messrs. Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne, for study at King's College, Newcastle-on-Tyne.

Announcements

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff, will be available for lectures on the Rothamsted experiments to agricultural societies and similar bodies. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

PROF. ALFRED KÜHN, director of the Kaiser-Wilhelm Institute of Biology, Berlin, Dr. Hugo Hassingen, professor of geography at the University of Vienna, and Dr. Hans Ahlmann, professor of geography at Stockholm, have been elected members of the Prussian Academy of Sciences in the physico-mathematical class.

THE Child Welfare Information Centre of the League of Nations has issued a useful analysis of reports received by the Secretariat from thirty-seven countries on the legislative and administrative measures that have been taken or have been under consideration during the year May 1937 to May 1938 with reference to any aspect of child welfare (London: Allen and Unwin. 3*s*.).

THE Child Guidance Council has awarded fellowships in psychiatry of the value of £300 and tenable for a year to Drs. Allen G. Crisp, Kenneth Soddy and Rosalind Vacher for half-time work at the London Child Guidance Clinic, 1 Canonbury Place, Islington, N.1.

THE New York banker, Mr. W. Childs, has left Yale University ten million dollars for cancer research.

THIRTY radio coast stations of the United States are provided with a medical man to give advice to passing ships.

THE London County Council has accepted a tender for £72,135 for building work in connexion with the erection of its new antitoxin establishment at Carshalton, which will afford valuable opportunities for research.

THE Ministry of Health with the collaboration of the Department of Health for Scotland and the National Fitness Council has arranged a permanent Health Exhibition which is being shown at the British Empire Exhibition and will be sent on to towns throughout Great Britain.

THE sixth Argentine Congress of Medicine, which will be held at Cordoba on October 16–21, will consist of three sections devoted respectively to biology, internal medicine and surgery.

THE twenty-fifth French Congress of Social Hygiene will be held at the Bordeaux Faculty of Medicine on September 30–October 2 under the presidency of M. Georges Risler. Further information can be obtained from Alliance d'hygiène sociale, 5 rue des Cases, Paris.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

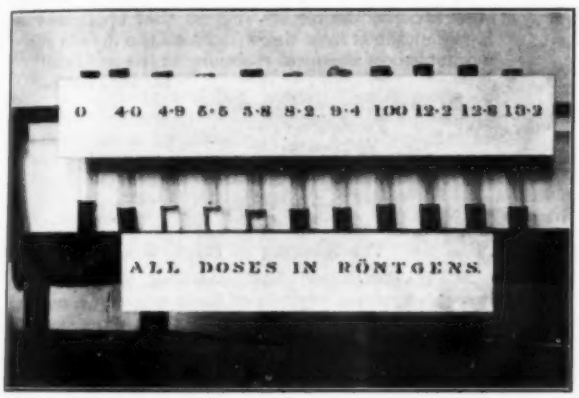
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 578.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Effect of Increasing Doses of X-Radiation on Colloidal Gold

SOME time ago, in a communication from this Department[1], it was shown that a steadily increasing exposure to X-radiation produced alternate increases and decreases in the electrokinetic potential of certain colloid particles. The colloid used at the time (a dilution of 'Aquadag' in water) is peculiarly stable, and at no stage were there any signs of coagulation. It was thought possible that with a more sensitive colloid the decrease in potential at the minima of the curve might be sufficient to bring the colloid to its flocculation point, and at my suggestion Dr. Liebmann and Mr. Jones have been working with certain pure gold sols.

After irradiation in a quartz dish by measured doses of X-radiation, the specimens of the sol were



transferred immediately to well-cleaned pyrex test tubes, and allowed to stand for a few hours. As will be seen from the attached photograph, specimens of the sol which had been exposed to doses of 4·9 and 5·5 röntgens were completely coagulated, and that exposed to a dose of 5·8 röntgens very largely so. On the other hand, specimens of the same sol, exposed to larger doses (8·2–12·8 r.) show no signs of precipitation. The last tube (13·2 r.) shows slight sedimentation, indicating the onset of a new coagulation dose.

The results are completely reproducible, for the given sol, and measurements with the ultra-microscope show that the doses producing coagulation are, in fact, those which produced the greatest decrease in the electrokinetic potential of the particles. The photograph illustrates very vividly the interesting fact that, at any rate for certain colloidal solutions, a comparatively small dose of X-radiation may produce complete precipitation, while a dose of twice the amount leaves the sol apparently unaffected. A further feature of interest is the very small quantity of radiation required to produce the effect.

It is hoped to publish further details of the measurements shortly.

J. A. CROWTHER.

Department of Physics,
University, Reading.
Aug. 1.

[1] NATURE, **140**, 28 (1937).

Structure of Age-Hardened Aluminium-Copper Alloys

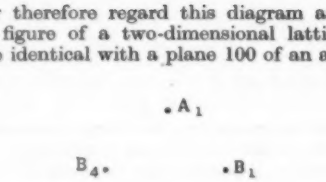
WE have made X-ray diagrams of aluminium-copper alloys (5 per cent Cu) age-hardened at various temperatures (25°–200° C.); the samples were composed of large crystals, and the radiation was made monochromatic by reflection by a crystal. In a previous paper[1], we described a new phenomenon which appeared in these diagrams: streaks of various length issuing from the centre, which we attributed to the reflection of X-rays by planes. We have shown that these planes are parallel with the 100 planes of the crystal of solid solution and, moreover, that they are of small dimensions (100–400 A.). We assumed, therefore, that these planes were composed of groups of copper atoms, without making any hypothesis about the disposition of the atoms within those groups.

Continuing the study of these alloys (among other things we have made use of molybdenum radiation besides that of copper), two other peculiarities were noticed:

(1) From the very intense spots produced by the X-ray reflection by the 111, 100, 110 planes of the solid solution, one or two straight streaks of varying dimensions and of very weak intensity issue. As to the spots 100, one is directed towards the centre, the other is perpendicular to it. As for the spots 111, 110, on the contrary, they may be inclined to the central radius.

(2) A number of distinct spots of extremely weak intensity appear, for which the crystals of the solid solution cannot be responsible. By orientating a given crystal so that the primary beam is parallel with an edge of the cube, the diagram which appears on a plate perpendicular to the beam is shown schematically in the figure below. The streaks in the centre are due to the groups of atoms included in the planes perpendicular to the plane of the figure, and the distance OA is equal to the distance from one spot 100 of the aluminium crystal to the centre; and the spots B_1, B_2, B_3, B_4 are in the middle of the lines A_1, A_2 . . .

We may therefore regard this diagram as the diffraction figure of a two-dimensional lattice, which would be identical with a plane 100 of an aluminium crystal.



Likewise, the study of the variation of the streaks described in the previous paragraph with the crystal orientation shows that these traces may be imputed to diffraction by such a two-dimensional lattice.

These new experiments enable us to determine more closely the structure of the plane groups which we have described; it seems that the copper atoms should gather in patches in the 100 planes of the solid solution during hardening and should thus produce three rectangular systems of two-dimensional lattice of small extent.

ANDRÉ GUINIER.

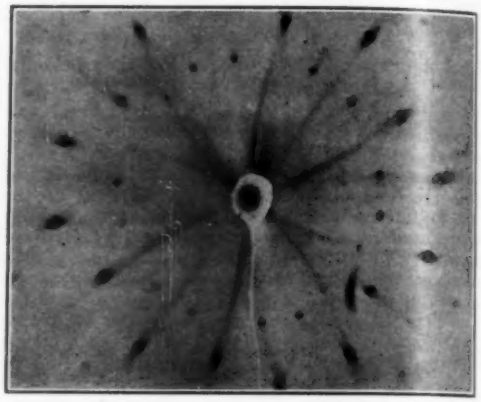
Laboratoire de Physique,
Ecole Normale Superieure,
Paris.
July 21.

[1] *C.R.*, **206**, 1641 (1938) and *C.R.*, **206**, 1972 (1938).

THE results reported by M. Guinier are of interest to us as similar work has been in progress during the past two years in this Laboratory, and we have arrived at virtually the same conclusions as those given by M. Guinier. A paper describing the results of my experiments was communicated to the Royal Society on May 10, and a brief abstract has already appeared[1]. Pending the publication of the full account, the following summary may be of interest.

The 'two-dimensional' diffraction effect, to which M. Guinier refers, produces a series of elliptical streaks on the Laue photographs of single crystals of an alloy of aluminium with 4 per cent of copper aged at room temperature. The accompanying photograph is of a crystal aged for six months at room temperature, orientated with a (110) direction parallel to the X-ray beam. The elliptical streaks make their appearance an hour after quenching the alloy; at first they are broad and faint, and in the course of a week, during which the alloy is hardening spontaneously, they become stronger and narrower, indicating that the area of the regions rich in copper is increasing.

If the alloy, age-hardened at room temperature, is heat-treated at 200° C., the first effect is a rapid reduction of hardness; the Brinell number falls from a figure of about 100 to 60 in ten minutes. At the same time the streaks disappear almost completely. Further heat-treatment leads to a rise in hardness to about 100 in a few hours; during this period the streaks reappear, but they are now quite narrow, showing that the plates of copper-rich metal are of considerable extent, of the order of 10^3 A., but still very thin, less than 10 A. If the heat-treatment is continued, the hardness falls slowly and the streaks on the Laue photographs begin to break up into ill-defined spots, which on further heat-treatment become increasingly sharper, and ultimately a new set of Laue spots, indicating the presence of well-developed crystals of a second phase, makes its appearance.



In addition to the metallurgical interest of these observations, the results suggest that application of X-ray methods may throw light on the details of the mechanism of chemical reactions in the solid state.

G. D. PRESTON.

National Physical Laboratory,
Teddington,
Middlesex.

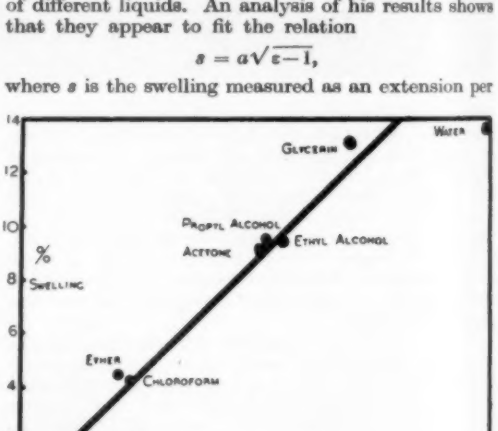
[1] *Proc. Roy. Soc.*, A, **166**, 872 (June 16, 1938).

The Swelling of Birch Wood

M. HASSELBLATT[1] has measured the maximum linear tangential swelling of birch wood in a number of different liquids. An analysis of his results shows that they appear to fit the relation

$$s = a\sqrt{\varepsilon - 1},$$

where s is the swelling measured as an extension per



unit length ; a is a constant of proportionality ; ε is the dielectric constant (or S.I.C.) of the liquid in which the wood is swollen.

The extent of the agreement is shown in the accompanying graph.

The above equation is in accord with W. Sementschenko's theory of absorption[2] if we assume that the mechanical strain energy per unit volume of swollen wood is proportional to the energy produced on absorption of molecules from the liquid by all the cellulose micelles in a unit volume of wood.

The strain energy per unit volume is $\frac{1}{2}Es^2$, where E is a mean value of Young's modulus of the birch ; the absorption energy is proportional to $(\varepsilon-1)$. Assuming proportionality between these two quantities, we see that the above equation at once results.

N. A. DE BRUYNE.

Aero Research Limited,
Duxford, Cambs.
Aug. 3.

[1] Hasselblatt, M., *Z. anorg. allg. Chem.*, **154**, 375 (1926).
[2] Sementschenko, W., *Z. physik. Chem.*, **129**, 176 (1927).

A Concentration and Measurement of Atmospheric Ozone

Prof. F. A. Paneth and Mr. J. L. Edgar are to be congratulated on having devised a new and ingenious chemical method of measuring both the ozone and nitrogen peroxide in the London atmosphere[1].

It is interesting to note that their measurements agree with those which I obtained as a result of five years' continuous measurements at both Plaistow and Upminster by means of an entirely different chemical method[2]. My mean figure for the ozone in spring air was given as $1{\cdot}2 \times 10^{-6}$ vol. per cent, whilst that of Prof. Paneth and Mr. Edgar is given as $1{\cdot}1 \times 10^{-6}$.

Prof. Paneth and Mr. Edgar's criticism that the older methods of analysis were not specific and did not distinguish between ozone and nitrogen peroxide does not apply to my own method, which was specific. I passed half the air through a tower filled with fine crystals of copper sulphate (which completely destroys the ozone but does not affect the nitrogen peroxide) and compared it with the other half containing both the ozone and the nitrogen peroxide. The ozone is obtained by difference.

There is an interesting point regarding the nitrogen peroxide in the atmosphere which my measurements of both town and country air brought out. Nitrogen peroxide is not a normal constituent of country air. Like the sulphur dioxide and ammonium chloride in town air (which I also measured), all three are the products of the combustion of coal. The percentage of all three increases in the winter. In country air near London the percentage of all three is trifling unless the direction of the wind brings them from London. The percentage of ozone is independent of the direction of the wind.

WILLIAM C. REYNOLDS.

16 Southern Drive,
Anlaby Park,
Hull.

[1] NATURE, **142**, 112 (July 16, 1938).
[2] *J. Soc. Chem. Ind.*, 168T (March 28, 1930).

IN the note on atmospheric ozone[1] we confined ourselves to a brief outline of our method, leaving the discussion of the great number of other chemical attempts at ozone measurements to an intended fuller publication ; there, of course, due credit will be given to the very interesting paragraphs dealing with atmospheric ozone determinations in Dr. W. C. Reynolds's paper on London air[2].

It has frequently been assumed that the presence of ozone in air is sufficiently proved by the observation that part of its oxidizing property is quickly destroyed by contact with various reagents. Dr. Reynolds made use of this effect for a quantitative ozone evaluation by determining the oxidizing power of air before and after this treatment. Whether such a method of measurement should be called "specific" for ozone is a question of terminology, but we are sure that Dr. Reynolds will agree that it is safer to collect the ozone in a pure state, to prove its identity by its absorption spectrum, and then to titrate it in a range of concentration in which the potassium iodide method has been found to be satisfactory. For highly diluted ozone this method of titration is liable to various errors, and the simultaneous titration both of ozone and nitrogen peroxide in such dilutions would have to be investigated very thoroughly before full confidence could be placed in it.

It is not obvious from Dr. Reynolds's paper whether such preliminary work has been done, but apparently he himself does not consider the nitrogen peroxide titration with potassium iodide as very satisfactory since he employs quite a different method when this gas is to be measured. Further, if anyone intends to apply such a differential method for the ozone determination, we should not recommend copper sulphate for the destruction of the ozone content of air ; according to our experiments, even in a slow current of gas this substance is likely to leave part of the ozone unaffected while manganese dioxide, which has been used for the same purpose by Usher and Rao[3], or charcoal, destroys it completely.

Nevertheless, it may well be that the figures obtained by Dr. Reynolds, as well as many of the other figures published by chemists on the ozone content of air, were essentially correct ; it can scarcely have been a mere coincidence that, by crude chemical methods, at least the right order was found long before any spectroscopic measurement was available. The trouble was not that these methods necessarily gave wrong results, but rather that their reliability could not be checked, and that there were not infrequently big discrepancies between results which seemed equally trustworthy. It is, in fact, our hope that a much simpler chemical method than the one described by us may be found to be sufficiently exact for meteorological purposes ; but there is scarcely a better way for deciding this than by comparison with a method which, by isolating and identifying the atmospheric ozone, is free from the obvious shortcomings of the older ones.

F. A. PANETH.
J. L. EDGAR.

Imperial College of Science
and Technology,
London, S.W.7.
Aug. 16.

[1] NATURE, **142**, 112 (1938).
[2] Reynolds, W. C., *J. Soc. Chem. Ind.*, **49**, 168T (1930).
[3] Usher, F. L., and Rao, B. S., *J. Chem. Soc.*, **111**, 799 (1917).

Neutrons and the Origin of Life

WHEN in early days of the development of the earth its surface was covered with an aseptic solution of various organic compounds, these did not react in the same way as they would have done if certain enzymes, colloids and other complicated substances had already been present[1]. The very first impetus to further development had to be given from molecules, containing, for example, carbon and nitrogen in certain combinations. One possible way of combining nitrogen and carbon, not yet discussed in this connexion, may be found in conjunction with certain nuclear reactions, also prevalent in Nature at those early days.

By the action of cosmic rays or hard γ-rays from radioactive matter present in the ocean, the deuterium of the heavy water, contained in the ocean water, will produce neutrons. These neutrons are slowed down in the water and will react with the nuclei of atoms in the molecules dissolved in the water. Thus, for example, a heavy carbon atom in an already existent carbon chain compound should be transformable (through a short-lived radioactive carbon isotope) into a stable nitrogen atom by expulsion of a β-particle:

$$^{13}_{6}C + ^{1}_{0}n \rightarrow ^{14}_{6}C^{*} \rightarrow ^{14}_{7}N + ^{0}_{-1}\beta$$

If the molecule in which this reaction takes place is not destroyed by the recoil or by the β-particle, the new nitrogen atom may give rise to a new, rather unexpected molecule containing a carbon-nitrogen link and capable of new reactions. In the same way also a phosphorus atom may be generated from a silicon atom and so on.

Even the direct action of very hard γ-rays on oxygen[2] is capable of producing a stable nitrogen atom (with mass number 15) through a short-lived radioactive oxygen isotope:

$$^{16}_{8}O + \gamma \rightarrow ^{15}_{8}O^{*} + ^{1}_{0}n$$
$$^{15}_{8}O^{*} \rightarrow ^{15}_{7}N + ^{0}_{+1}e$$

Thus various complicated organic molecules containing, for example, carbon-nitrogen may have originated in a way rather different from ordinary chemical reactions and will perhaps have influenced the evolution of organic matter, eventually leading to the first primitive forms of living matter, no longer present on earth.

JOHN TANDBERG.

Electrolux Laboratory,
Stockholm.
Aug. 15.

[1] Compare Oparin, A. J., "The Origin of Life" (New York, 1938).
[2] Chang, Goldhaber and Sagane, NATURE, 139, 962 (1937).

Condensation Coefficients of Mercury Halides

USING the method of Alty[1], we have measured the coefficients of condensation (f) of the compounds mercuric chloride, bromide and iodide. A hemispherical cap of these salts was deposited by sublimation on the end of a glass tube which could be heated internally by boiling turpentine. The temperature of the cap surface was measured by a fine thermocouple while the salt evaporated in a high vacuum. The quantity of salt evaporated per unit time and area (M_1) was determined by weighing the deposit on a surrounding glass tube immersed in liquid air. By calculating the maximum rate of evaporation (M_2) from the formula of the kinetic theory of gases,

$$M_2 = \frac{0{\cdot}0584\sqrt{M}}{t}\int^{t}\frac{P}{\sqrt{T}}\,dt \text{ gm./cm.}^2 \text{ sec.},$$

where P is saturated vapour pressure (mm. mercury), M is molecular weight, t is time of evaporation, T is absolute temperature, one finds $f = M_1/M_2$.

The mean of the results of three or four runs for each substance is as follows:

$HgCl_2$	$HgBr_2$	HgI_2
$0{\cdot}76 \pm 0{\cdot}1$	$0{\cdot}64 \pm 0{\cdot}1$	$0{\cdot}53 \pm 0{\cdot}1$

For calculating M_2 the saturated vapour pressures P were extrapolated from the formulæ given in the "Critical Tables". The extrapolated values seem to be a little too small as compared with single direct measurements[2], and for this reason the coefficients f may be close to unity. This means that each molecule striking the solid surface condenses at once. The mercury halide molecules being linear have no dipole moment, and so this result is not inconsistent with Alty's empirical rule that the coefficients f for non-polar molecules are near unity.

F. METZGER.
E. MIESCHER.

Physical Institute,
University of Basle.
Aug. 22.

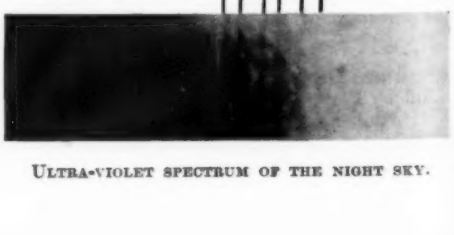
[1] Alty, *Proc. Roy. Soc.*, A, **161**, 68 (1937).
[2] Kelley, *Bull.*, 383, U.S. Dep. of the Interior, Bureau of Mines, Washington (1935).

Probable Dissociation of Nitrogen Molecules in the High Atmosphere

KAPLAN[1] recently succeeded in exciting, in the afterglow of nitrogen, a line, λ 3471 A., that probably corresponds to the forbidden transition $^2P \rightarrow {}^4S$ of NI. Theoretically it is very interesting and curious to see that this line is emitted under relatively high pressure, at the same time as the Vegard-Kaplan bands, which are themselves forbidden.

Here, however, I wish chiefly to direct attention on the application of this beautiful experiment to the knowledge of physical conditions of the upper atmosphere. Indeed, as Kaplan points out, Dufay[2] and Gauzit[3] mentioned the presence of an intense radiation at a wave-length λ 3471 A. in the spectrum of the night sky; new observations, made by me, confirm very clearly the existence of this radiation and its intensity, as it is easy to see on the accompanying spectrum. Probably we have here the line of NI, as Kaplan suggested two years ago[4].

The two arguments which prevented acceptance of this attribution have now disappeared. First, the



ULTRA-VIOLET SPECTRUM OF THE NIGHT SKY.

line λ 3471 A. has been produced in the laboratory. Further, while the dissociation during the day by absorption of ultra-violet light from the sun is certainly very slight, any other process seemed impossible; we thought that the energy for excitation of the light of the night sky—which does not exceed 7 electron volts—is not sufficient to dissociate the nitrogen molecule. But this energy of dissociation was not accurately known; the value (9·0 volts) accepted a few years ago is now recognized as too high; the value adopted to-day[5] is 7·34 volts. We can consequently accept the dissociation of nitrogen molecules.

In a recent paper, Bernard[6] shows that a radiation at λ 3471 A. is also present in the spectrum of diffuse auroras, where the Vegard-Kaplan bands are particularly intense. This is an interesting confirmation of the probable presence of metastable N_I atoms in the high atmosphere. But Bernard's paper requires two comments:

(1) Vegard and his collaborators probably observed the line λ 3471 A. in the aurora; they did not separate it from the second-positive band near 3469 A.; the intensity attributed to this band is evidently too high.

(2) The line λ 5206 A., which corresponds to the $^2D - {}^4S$ transition of NI, has not yet been recognized in the night sky; but its existence in the spectrum of the aurora was pointed out by V. M. Slipher and L. A. Sommer[7], who suggested its origin and mentioned that the line had been observed[8].

In conclusion, I propose seeking the λ 5206 A. line in the spectrum of the night sky by a right choice of photographic plates and studying the λ 3471 A. radiation of the night sky by the interferometer method, in order to ascertain for certain the existence of nitrogen atoms in the high atmosphere.

J. GAUZIT.

Observatoire de Lyon.
Aug. 2.

[1] Kaplan, NATURE, **141**, 645 and 1139 (1938).
[2] Dufay, *J. Phys.*, vii, **5**, 523 (1934).
[3] Gauzit, *J. Phys.*, vii, **5**, 527 (1934).
[4] Kaplan, Quatrième rapport de la Commission pour l'étude des relations entre les phénomènes solaires et terrestres, p. 140 (1936).
[5] See, for example, Mathur, L. S., and Sen-Gupta, P. K., *Proc. Acad. Sci. U.P.*, **5**, Part 2, 187–226 (1938).
[6] Bernard, NATURE, **141**, 1141 (1938).
[7] Slipher and Sommer, *Naturwiss.*, **171**, 802 (1929).
[8] See Kayser, "Handbuch der Spektroscopie", **5**, 57.

Angular Distribution of Electron Pairs

A NUMBER of experiments have been made on the angular distribution of electron-positron pairs liberated by a beam of γ-rays, but the results, where it is possible to compare them, do not seem to be in agreement. It is therefore of interest to see what the theory predicts, and in the following a short account is given of the results obtained by a rigorous treatment of the problem. The method used is an extension of that given by us[1] to find the total number of pairs created. So far, the calculations have been made for Z (atomic number) = 84, $h\nu = 5\ mc^2$, and $Z = 50$, $h\nu = 3\ mc^2$ and $5\ mc^2$, where $h\nu$ is the energy of the γ-ray.

Denoting the *average* angles made by the direction of the electron and positron with the direction of the γ-ray by θ_e and θ_p respectively, and the *average* angle between the pair by γ, the following results were obtained.

(1) θ_e, θ_p and γ decrease with increasing energy of the γ-ray. For particles of definite energy, the formula given by Bethe and Heitler[2] for the number of electrons of energy E_0 emitted at an angle θ_0

$$\Phi(\theta_0)d\theta_0 = \frac{\theta_0\, d\theta_0}{(\Theta^2 + \theta_0^2)^2}\ , \quad \Theta = \frac{mc^2}{E_0},$$

is not valid for such low energies. The values found for θ_e, θ_p and γ when $Z = 84$ are about twice those given by the above formula ($h\nu = 5\ mc^2$).

(2) θ_e is slightly greater than θ_p. This is to be expected since the average energy of the positron is greater than that of the electron. This is in qualitative agreement with Grosev and Frank[3], who find for krypton $\theta_e = 33°$, $\theta_p = 30°$.

(3) θ_e, θ_p and γ increase slowly with Z. It is easy to show that the angular distribution is independent of Z to the first order (Born approximation), but for large Z the electrostatic forces on the particles become important, and these must be responsible for the increased values of θ_e, θ_p and γ noted in (1). The strongest evidence in support of this would seem to be Alichanian's experiments[4] on lead, with $h\nu = 14\ mc^2$. He found γ to be about 65°, as compared with 48° in krypton[3] for a considerably lower energy ($h\nu = 5\ mc^2$). Similar results have been obtained by Jelepov (ref. 3, p. 52, footnote).

The calculations involved in the use of the accurate wave functions are extremely laborious, particularly the evaluation of γ, the angle between the pair. For purposes of comparison with the theory it is therefore advantageous to have experimental results for θ_e and θ_p. It is hoped to publish fuller details and results shortly.

J. C. JAEGER.

University of Tasmania.

H. R. HULME.

Royal Observatory,
Greenwich.

[1] Jaeger and Hulme, *Proc. Roy. Soc.*, A, **153**, 443 (1936).
[2] Bethe and Heitler, *Proc. Roy. Soc.*, A, **146**, 83 (1934).
[3] Grosev and Frank, *Comptes rendus (Doklady)*, **19**, 52 (1938).
[4] Alichanian, Dzelepov and Spivac, *Comptes rendus (Doklady)*, **19**, 379 (1938).

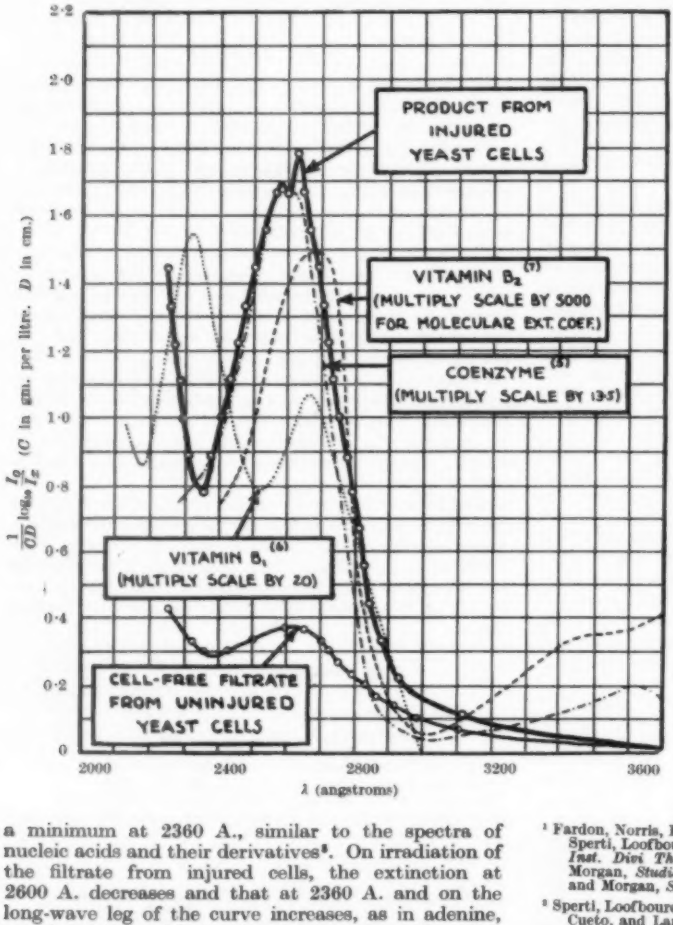
Chemical Nature of Proliferation-Promoting Factors from Injured Cells

WE have published investigations indicating that yeast[1] and animal cells[2] injured by ultra-violet light and other means produce factors ('intercellular wound hormones')[3] which are apparently released by injured, but living, cells into the intercellular fluid and stimulate the proliferation of normal cells. Spectrographic and chemical studies indicate that the active materials from yeast contain nucleic acid derivatives, as previously suggested[4].

The 'wound hormones' were produced by prolonged, low-intensity, full ultra-violet irradiation of yeast in isotonic salt solution or distilled water. Cell-free Berkefeld filtrates from irradiated and non-irradiated suspensions were assayed in yeast growth experiments. The biological potency and extinction at 2600 A. were much more marked in the filtrates from irradiated suspensions, and the potency and 2600 A. extinction in various samples were closely parallel.

As shown on the accompanying graphs, the spectrum of the 'wound hormone', or factor from injured cells (obtained by photographing the spectrum

of the filtrate from irradiated yeast with filtrate from non-irradiated yeast in the comparison cell) is characterized by a marked maximum at 2600 *A.* and



a minimum at 2360 A., similar to the spectra of nucleic acids and their derivatives[8]. On irradiation of the filtrate from injured cells, the extinction at 2600 A. decreases and that at 2360 A. and on the long-wave leg of the curve increases, as in adenine, guanine, etc.[8]. Of absorbing components of nucleic acids, the spectrum least resembles that of uracil or cytosine. Guanine is suggested by the broadness of the curve and adenine by the 2600 A. maximum. The spectrum is markedly different from that of vitamin B_1.[7] It lacks the long-wave maximum of vitamin B_2.[9] It is similar to that of coenzyme[9].

Filtrates from both irradiated and non-irradiated suspensions contained nitrogen and phosphorus but not halogens or sulphur (negative lead acetate, nitroprusside and Sullivan reactions before and after sodium fusion). Both contained pentose (Bial test) but apparently not desoxypentoses (Kiliani test[10]). The Thomas[11] β-napthol test gave a blue ring with both materials and a non-uniform brownish colour with the Thomas[11] tryptophane reagent. Negligible reducing activity was shown with Benedict's solution, and substantial freedom from protein by the biuret test. Both materials gave positive murexide[12], Kossel[13], and diazo[14], and negative Weidel[12] and Wheeler-Johnson[15] tests. The positive reactions were more marked with the filtrates from irradiated suspensions. Slight turbidity or opalescence was obtained from phosphotungstic, picric, and metaphosphoric acids. No precipitate formed with $HgCl_2$. Contrary to previous indications[4], no positive colour reactions[16] could be obtained for pyridine even after boiling. The active materials gave *p*H values of about 5·5 (glass electrode) in concentrations of 0·5 to 1·5 mgm. per c.c. They were soluble in water and 50 per cent alcohol, slightly soluble in 95 per cent and absolute alcohol, and insoluble in ether and petroleum ether. Their activity was not reduced by autoclaving at 20 lb. for 15 minutes.

A correlation of the spectrographic and chemical data shows the presence of phosphorus, pentoses, guanine and adenine. Uracil, cytosine, pyridine, and vitamins B_1 and B_2 are not indicated, and yeast nucleic and adenylic acids seem to be ruled out by the Thomas[11] tests. Of related substances, resemblance is closest to cozymase[17] or coenzyme[9]. The presence of guanine and the apparent absence of pyridine suggest that, though similar to it, the 'wound hormone' is not identical with coenzyme or cozymase.

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Mutation of the Blood-Group Genes

THE current theory of the mutation of the blood-group genes postulates the appearance of gene *A* by mutation in one or more sites in the Europe-Asia land mass, and a similar appearance of gene *B* in India and in Africa.

There is little doubt that the mutation giving rise to gene *A* and *ipso facto* to group *A*, must have been a replacement of, or a change in, gene *R*, but the same certainty does not hold for the mutation of gene *B*. Gene *B* may have been a replacement, in one form or another, of gene *R* or of gene *A* or of both genes. Each of these three possibilities implies a different pre-mutation distribution of the genes in the races concerned.

If gene *R* alone was susceptible to *B*-mutation, then the pre-mutation frequency of *R* in a race undergoing this change must have been equal to the sum of the post-mutation frequencies of *R* and *B*, and the frequency of gene *A* would be unaltered by the phenomenon.

If gene *A* alone was susceptible, then the frequency of gene *R* would be unaffected by the change, and the pre-mutation frequency of *A* would be equal to the sum of the post-mutation frequencies of genes *A* and *B*.

If both genes were liable to change, then, had the mutation affected all the susceptible genes, the present frequency of gene *B* would be 100 per cent, and for less complete changes the effect of the mutation is given by the equation:

$$A = \frac{a}{1-b},$$

where A is pre-mutation frequency of gene *A*, *a* is post-mutation frequency of gene *A*, *b* is post-mutation frequency of gene *B*.

This means that in the Hindu, if *R* alone were susceptible, the pre-mutation frequency of *A* must have been 0·149; if *A* alone were susceptible, this frequency must have been 0·440; and if both were susceptible, the frequency of *A* prior to mutation must have been 0·210.

The fact that there are no races showing gene *B* without some gene *A* suggests that the presence of *A* is a *sine qua non* to the appearance or mutation of *B*. It follows from this that *B*-mutation was a change in gene *A* alone.

If this be the case, then the pre-*B*-mutation frequency of *A* will show a maximum in the centre of the Europe-Asia land mass, as opposed to the minimum in the same place shown by the post-*B*-mutation frequency of *A*. This is an attractive idea, as it would imply a single mutation of gene *A*.

In what races other than the Hindu is there direct evidence of *B*-mutation? It is generally accepted that there must have been such a change in Africa, but the site of this change is generally considered to have been West Africa, mainly because the Yoruba and the Senegalese show a biochemical index of less than unity. However, these peoples could have obtained their present distribution as a result of the mixing of other races in Africa. The only races having *B* in Africa about which this cannot be said are the pygmies and the Egyptians. These peoples each show a high proportion of both *A* and *B*, and could have given rise one to the other, but this seems unlikely on other grounds. They could not have received their gene distributions by the crossings of any other known races, even including the Hindu.

If we accept the conception that *B*-mutation was a change in gene *A* and not in gene *R*, then the distributions of these races could not have arisen from any extant race or races by mutation, but their pre-*B*-mutation frequency of gene *A* must have been considerably higher than that shown by any modern races, and in fact, higher than that shown by the pre-*B*-mutation phases of any other people.

This implies one of two possibilities: either there was a mutation of *A* in Africa, or Africa was invaded by peoples having a very high proportion of *A*. When one bears in mind the extreme bastardization of the modern Bush people, it seems likely that they too, in their purer forms, must have had a similar proportion of *A*. Now did these various peoples, Bush, Pygmy and Egyptian, receive their *A* from the same source, and was this source an African *A*-mutation, or was it the main mass of mankind?

Finally, there is a third, and very interesting possibility, namely, that Africa was the site of the main *A*-mutation, and that peoples outside Africa have obtained their *A* from that continent.

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Pleistocene Site in the Malay Peninsula

IT was to be regretted that until recently no artefacts of Pleistocene age had been found in the Malay Peninsula, and particularly so because of the relationship of the peninsula to the now sunken Sundaland which formerly joined Sumatra, Java and Borneo to the mainland of Asia.

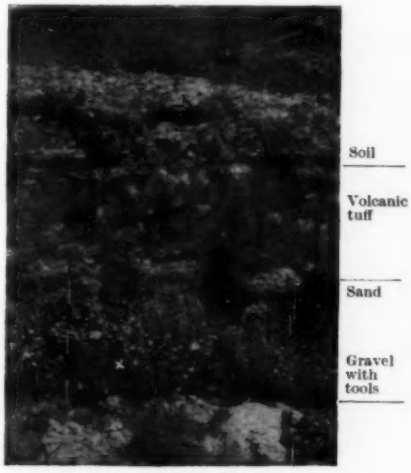

Fig. 1. (Scale in feet.)

Acting on a suggestion of Mr. E. S. Willbourn, director of the Geological Survey, F.M.S., I visited the Kota Tampan Rubber Estate which lies on the west side of the Perak River about three and a half miles south of Lenggong, Upper Perak. On this estate is a deposit of volcanic tuff overlying a bed of sand and gravel which itself rests on laterite. The site lies just below the 250 ft. contour and is probably an old terrace of the Perak River. Since there have been no recent volcanoes in Malaya, a foreign origin

had to be supposed for the tuff, specimens of which were kindly examined by the Netherlands Indies Vulcanological Survey in Bandoeng, who reported that it probably came from "the big Toba-eruption", which was the origin of Lake Toba in Sumatra. Fig. 1 shows a stream-cut section of the deposits, but the underlying laterite cannot be seen.

In this and two other nearby gravel beds were found stone tools, typical specimens of which are shown in Fig. 2. The majority are made from pebbles of quartzite and most of them are unrolled or only slightly rolled. They comprise: (*A*) 'Chopper', with just enough flaking to make an edge. This is the commonest type. (*B*) 'Chopper', of very fine grained rock; the exact find-spot is shown by the cross in Fig. 1. (*C*) Hand-axe, triangular section, rolled, the only specimen found. (*D*) Hand-axe; the butt has been flaked to reduce the size of the tool.

The characteristics of these tools are that they are made from pebbles with the minimum flaking on one side only, and the cutting edge is always made by the meeting of a flaked surface with the unworked natural pebble skin.

The other types consist of flakes worked up into end-scrapers, hollow-scrapers and points, together with a large number of pebbles used as hammer-stones. The latter tools would seem to show that the place was a workshop and perhaps even a dwelling site.

As yet not enough specimens have been found to warrant detailed comparison with other cultures, and dating is not possible on palæontological grounds since no fossils were found. There does, however, seem to be an undoubted kinship with the Pajitan culture described by von Koenigswald from central Java[1], but it differs from it in the complete absence of bilateral flaking and in the greater amount of original pebble surface which is preserved. It may therefore be an earlier phase of the Pajitan culture. The commonest type (Fig. 2A) is very much like a Pre-Stellenbosch tool from South Africa illustrated by van Riet Lowe[2].

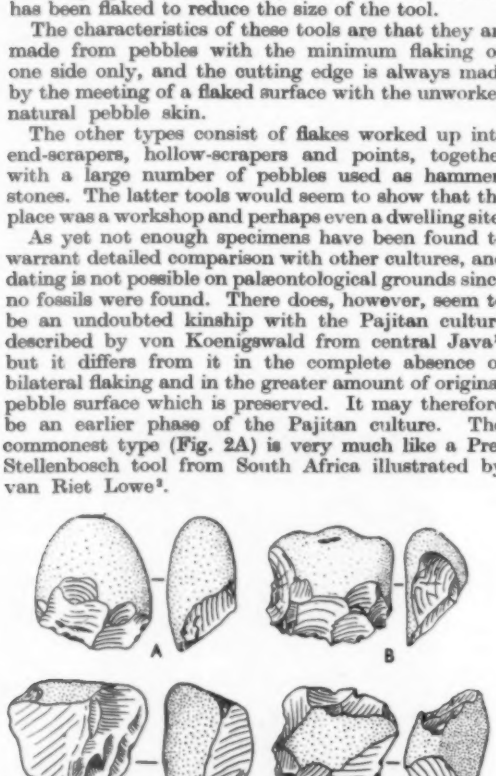

Fig. 2.

It is hoped to carry out further excavations in the near future, and in the meanwhile I propose the name *Tampan Culture* to describe the tools from this, the first Pleistocene archæological site to be found in the Malay Peninsula.

Raffles Museum, Singapore, S.S. July 29. H. D. COLLINGS.

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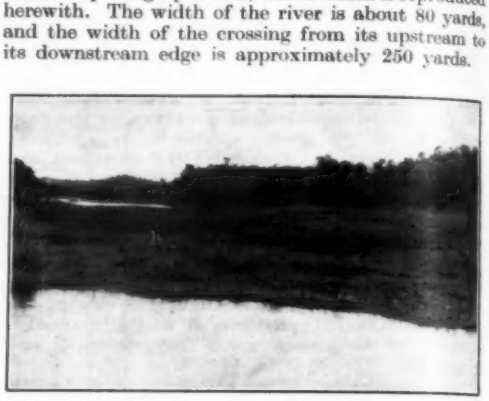
Dry Crossing of the Nile

THROUGH the co-operation of Dr. Alexander Cruickshank, senior medical inspector of the Equatorial Province of the Sudan, and of my son, Lieut.-Colonel F. O. Cave, I am able to give some recent particulars of 'Wayland's crossing', or the dry crossing of the Nile. Dr. Cruickshank visited it last Easter and took photographs of it, one of which is reproduced herewith. The width of the river is about 80 yards, and the width of the crossing from its upstream to its downstream edge is approximately 250 yards.



WAYLAND'S CROSSING, EASTER 1938, LOOKING DOWN-STREAM. WIDTH OF RIVER, APPROXIMATELY 80 YARDS; DEPTH OF CROSSING APPROXIMATELY 250 YARDS.

In places the accumulated vegetation exceeded 10 feet in thickness, but at the edges it was loose and thin in places, and one of Dr. Cruickshank's porters fell through. But away from the edges, and presumably in some parts at the edges, it was thick enough for elephants to cross, for recent elephant spoor was found. On the surface there was a thick ash deposit left after grass and papyrus had been burnt. It would appear from Dr. Cruickshank's account that there are no signs of the crossing breaking up at present.

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Distribution of the Polychæte *Ophelia cluthensis* McGuire

Ophelia cluthensis was described in 1935 by McGuire[1], who obtained her specimens from Millport in the Clyde, and more fully in 1938 by Brown[2]. It occurs in a narrow zone of sandy beaches just below high-water mark neaps, frequently to the extent of several hundred to the square metre. Besides being recorded from the Firths of Clyde and Forth, Wohlenberg[3] records its presence at Sylt, Germany. Specimens obtained by Fauvel[4] at Saint-Vaast, France, were described by him as young *O. limacina* but are considered by Brown to be probably *O. cluthensis*.

As a result of recent shore collecting I have now to record the species from South Wales and Ireland. The Welsh specimens were obtained from a small area of the beach at Lavernock in the Bristol Channel, about four miles along the down-channel coast from Cardiff. The salinity at high water at this point varies from 20 per mille in winter to 28 per mille in

summer. The Irish specimens were obtained from a sheltered bay at Falcarragh, Co. Donegal, about six miles east of Bloody Foreland. The salinity of the water here is affected, particularly at low water, by a stream of freshwater. At one station 1,100 specimens per square metre were counted. At both places the sand was of fine grade with a small quantity of silt.

I am obliged to Dr. A. C. Stephen for confirming my identification, and for the information that the Welsh animals are quite typical, but that the Irish specimens show a certain amount of variation. In both cases the animals are small, the largest being only 8 mm. in length, so that these variations are probably due to immaturity.

The addition of these two records lends support to Dr. Stephen's opinion that *O. cluthensis* is considerably more common than the previous records suggest. It seems certain that this species has been frequently overlooked or dismissed as a juvenile form.

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[1] McGuire, *Scot. Naturalist*, 45 (1935).
[2] Brown, *Proc. Roy. Soc. Edin.*, **58** (2), 135 (1938).
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Connexions of the Pterygoquadrate in the Tadpole of *Philautus variabilis* (Anura)

WHILE examining the chondrocranium of Ranid and Rhacorphorid (Polypedatid) genera of frogs, the connexions of the pterygoquadrate with the cranium were found to vary considerably. It is well known since the time of Parker[1] and Gaupp[2] that in the anuran larvæ, the pterygoquadrate gains attachment with the cranium normally in three regions, namely, an anterior ligamentary or, in the majority of cases, a cartilaginous quadrato-ethmoidal connexion; the second connexion is in the posterior orbitotemporal region, called the processus ascendens, which bears definite relationship with the three branches of the Vth. cranial nerve. When the tadpole undergoes metamorphosis, this larval connexion is lost (say in the case of *R. fusca* larva (S. *temporaria*) 29 mm., de Beer[3]) and the adult is without one. There is no anuran larval form described where, in the larval stages prior to metamorphosis, the absence of a processus ascendens is described. The last connexion is the oticus one; the posterior portion of the pterygoquadrate unites with the dorsal wall of the otic capsule over the cranioquadrate passage. This connexion, however, may be absent from some tadpoles.

Now, with regard to the genera which I have examined, *Philautus variabilis* Günth. (tadpoles kindly identified by Prof. C. R. Narayan Rao) needs special mention. I have examined the sectional views of at least two tadpoles of each of the stages measuring 22 mm. and 24 mm. (head and trunk 10 mm.) and 31 mm. (head and trunk 11 mm.) in all of which the posterior limbs have not appeared. All these tadpoles belong to premetamorphic stages. While the anterior connexions of the pterygoquadrate with the cranium are normal, the sections of the posterior orbitotemporal region do not show the presence of the connexion of a processus ascendens palatoquadrati with the pila antotica or an oticus connexion with the otic capsule, there being a little connective tissue between the posterior portion of the pterygoquadrate and the cranium, and so far as is known to me the absence of both these connexions in the larval anura is not recorded. This is a remarkable feature in *P. variabilis*, and if the processus ascendens connexion has broken down as early as the stage studied, then it is an excellent example of developmental acceleration or heterochrony. If, on the other hand, the connexion is not established at all, which I think is more probable, then *P. variabilis* is the first anuran larval form where both the processus ascendens and oticus connexions are wanting.

Further study of the development of the cranium in this and allied forms is engaging my attention, and the result will be published elsewhere.

My thanks are due to Prof. A. Subba Rau for helpful criticisms.

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[2] Gaupp, E., *Morph. Arb.*, **2** (1893).
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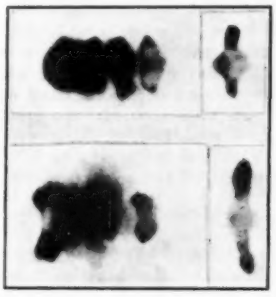
Differentiation of Heterochromatic Regions during Meiosis

HETEROCHROMATIC regions have been revealed in the somatic cells of a large number of plants and in certain animals during the metaphase by many investigators. They are usually situated around the centromeres and at the distal ends. One of the characteristic properties of the heterochromatic regions is the intensive absorption of hæmatoxylin and other stains. Genetically, they are poor in genes in *Drosophila* and are usually called 'inert regions'.



The chromosomes have usually a spiral structure during the meiotic metaphase. This is characteristic for both heterochromatic and euchromatic regions. Differentiation of heterochromatic and euchromatic regions in pure species during the meiotic metaphase is technically more difficult than in some species

hybrids, where one of the parents has longer chromosomes, obviously with a larger amount of heterochromatic substance than the other. The accompanying illustration shows two meiotic metaphases in side view and two single bivalents from two other meiotic plates of the amphidiploid *Nicotiana glauca* × *N. Langsdorffii*. Both single bivalents have darker regions at the portions turned towards the poles, where the centromeres are obviously situated. The bivalents at the left side of both metaphase plates are darker than the right (lighter) pairs of each plate. The former have probably more heterochromatic substances than the latter. Each of the lighter bivalents of these two plates has two chiasmata; their centromeres, directed towards the poles, are surrounded with small heterochromatic (darker) portions.

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Points from Foregoing Letters

A PHOTOGRAPH is submitted by Prof. J. A. Crowther showing the effect of increasing doses of X-radiation on colloidal gold. The photograph shows that, whereas the sol is completely precipitated by doses of 4·9–5·5 röntgens, larger doses of 8–12·8 röntgens leave the sol completely stable.

In X-ray diagrams of age-hardened aluminium-copper alloys, A. Guinier finds diffraction spots produced by two-dimensional lattices, suggesting that the copper atoms form small plane groups, where they maintain a regular disposition. G. D. Preston reports a similar effect, observed in Laue and oscillating crystal photographs during the process of age-hardening of an alloy of aluminium with 4 per cent copper. He ascribes it to the segregation of copper atoms of relatively high scattering power on widely separated (100) planes of the aluminium lattice.

Dr. N. A. de Bruyne finds that the maximum linear swelling of birch wood is related to the dielectric constant of the swelling liquid by an equation which has a simple theoretical interpretation.

Dr. W. C. Reynolds points out that the percentage of ozone in London air found by Prof. F. A. Paneth and J. L. Edgar, namely, $1{\cdot}1 \times 10^{-6}$ vol. per cent, agrees with that which he obtained during five years' measurements by an entirely different specific chemical method. Prof. Paneth and Mr. Edgar comment on a few essential differences between their method and those previously employed for the determination of atmospheric ozone.

Dr. J. Tandberg suggests that nuclear reactions may have influenced the development of organic matter in the ocean in primeval times. Organic molecules may on rare occasions have had a carbon or oxygen atom transformed into nitrogen as an impetus to new and rather unexpected reactions, resulting in organized systems with colloids, leading to primitive forms of living matter.

The coefficients of condensation of mercury chloride, bromide and iodide are calculated by F. Metzger and Dr. E. Miescher to be 0·76, 0·64 and 0·53 respectively, using the formula of the kinetic theory of gases. Owing to uncertainty in the extrapolated values of the saturated vapour pressure the authors infer, however, that the condensation coefficients may be close to unity, which would mean that each molecule striking the cold solid surface condenses at once.

Prof. J. Gauzit states that his new observations of the spectrum of the night sky confirm the presence of an intense λ 3471 A. radiation, which probably coincides with the line recently excited by Kaplan in the high-pressure nitrogen afterglow. Recent determinations reduce to 7·34 volts the energy of dissociation of nitrogen molecules, and thus dissociation in the high atmosphere is probable. The line λ 5206 A., which corresponds to the transition $^2D - {}^4S$ of NI, has already been observed in the auroral spectrum.

By calculations involving the use of accurate wave functions, J. C. Jaeger and Dr. H. R. Hulme estimate that the average angles made by the electron and the positron with the beam of gamma rays by which they are liberated, and also the average angle between the electron and positron, decrease with increase in energy of the gamma rays and increase slowly with the atomic number of the atom involved. The average angle for the electron would be slightly greater than for the positron.

The chemical nature of the factor producing cell-proliferation, formed by the action of ultra-violet light upon yeast cells, and generally when cells are injured (wound hormones) has been investigated by Prof. J. R. Loofbourow, E. S. Cook, and Sister M. M. Stimson. Its absorption spectrum is similar to that of cozymase or coenzyme but the presence of guanine and the apparent absence of pyridine suggest that it is a different substance.

Assuming that the gene responsible for the *B* blood group reaction arose from a mutation of a gene responsible for the *A* blood group reaction (or admitting, at any rate, the presence of *A* before the presence of *B*), Dr. R. Elsdon-Dew discusses the probable place of origin of the genes in the light of the present geographical distribution of the various blood groups among African peoples.

The discovery of artefacts of Pleistocene age in gravel underlying volcanic tuff at Tampan, Malay Peninsula, is reported by H. D. Collings.

Records of the distribution of *Ophelia cluthensis* McGuire in Wales and Ireland are added by C. B. Rees to previous records from Scotland, Germany and France.

Dr. L. S. Ramaswami reports that in the cranium of two tadpoles of *Philautus variabilis* he has been unable to find either the processus ascendens or the oticus connexions and, unless the connexions had broken down at an unusually early stage, this would be the first case of anuran larvæ in which those connexions are absent.

Research Items

Stone Age Cultural Succession in Southern Rhodesia

A ROCK-SHELTER on the Nyazongo Mountain, twenty miles to the north of Penhalonga and ten miles from the eastern border of Southern Rhodesia, has been excavated by Mrs. C. Martin with the view of ascertaining whether a sequence comparable to that established by A. L. Armstrong for the Bambata Cave also occurs throughout Mashonaland, and, if possible, of determining the predecessor of the Wilton culture on the eastern border. A trial trench dug in October 1936 was extended in 1937 to a total measurement of nine feet by ten. Mrs. Martin's report is supplemented by technical reports by the late Father P. Stapleton, dealing with the implements, and by Mr. L. H. Wells, dealing with the pottery (Queen Victoria Memorial Library, Salisbury, *Occasional Paper* No. 1, 1938. Pp. 18. 5*s*. net). The existence of two stone age industries was established, Bambata and Wilton. The lower is characterized by broad flakes of both greenstone and quartz and 'points' in both materials. This occupies the third and fourth foot of the excavation. It predominates in the fourth foot, and in the third is mixed with Wilton. It does not appear in the higher levels, but is found below the fourth foot level and under the ledge in front of the cave. This confirms the conclusion that this is the earliest industry of the shelter. The points show that it is a Bambata industry, though it is not the latest phase of that industry. The upper culture is Wilton. It occurs first in the fourth foot, more than fifty specimens being counted from that horizon; but from the third foot some one hundred and fifty were recovered, and from the first two feet more than three hundred. There is no break between the industries. Though they were not contemporaneous, the interval between them cannot be long. Ground axes belong to the Wilton horizon, though not to the earliest part. The custom seems to have come in during the Wilton occupation. The fragments of pottery found in abundance in the uppermost foot and occasionally in the second foot fall into four or rather three groups, which may be resolved into two types, belonging either to the previously known 'pit-circle' people, or the later Manyika inhabitants.

Recent Botanical Exploration of China

PROF. H. H. HU has recently reported upon his botanical collections in China since 1920 (*J. Roy. Hort. Soc.*, **63**, Pt. 8; August 1938). Although many garden plants of proved excellence are of Chinese origin, that country must hold many more botanical or horticultural treasures. A beautiful new species, *Sinojackia xylocarpa*, was, for example, found in a suburb of Nanking. A rich harvest of new species is cited in the paper, and several of them are figured upon very clear lithographs. Prof. Hu's collections have been mainly from south-western Yunnan, and three distinct elements have been recognized in the flora, namely, the Burmese, the Indo-Chinese and the endemic. The Indo-Chinese elements link the Yunnan flora with that of Kwangtung, Kwangsi, Hainan and Formosa. Species of the genera *Camellia*, *Adinandra* and *Eurya* are the chief endemic plants, but a number of new rare genera are also represented. Many Burmese genera are found in Yunnan but not elsewhere in China.

History of Rhubarb Cultivation

THE use of rhubarb for medicinal purposes is of considerable antiquity, for the Chinese herbal of Pen-King mentioned its corrective properties as early as 2700 B.C. Miss D. M. Turner has made a study of the economic significance of various kinds of rhubarb from that date until the present time (*J. Roy. Hort. Soc.*, **63**, 8; August 1938). Though known in classical times, it was not until the thirteenth century that roots of the 'rhapontic' rhubarb were brought to Europe by Marco Polo. Herbals of the seventeenth and eighteenth centuries mentioned several kinds, and the plant attained culinary popularity about 1750. Miss Turner's paper considers the history, taxonomy, hybridization and varieties of *Rheum rhaponticum*, *R. palmatum*, *R. undulatum*, and other species. Forcing of the plant during winter was apparently discovered by accident at Chelsea in 1817, and the history of rhubarb-forcing in the south West Riding of Yorkshire makes interesting reading. The climate of this region, though unsalubrious for man and many other organisms, is completely adjusted to the needs of rhubarb grown for forcing.

Compounds of Divalent Europium

PRESENT knowledge of the compounds of divalent europium makes it probable that in this state the metal behaves like an alkaline earth metal, intermediate in properties between strontium and barium. G. Beck and W. Nowacki (*Naturwiss.*, **26**, 496; 1938) report experiments on the preparation and crystal structure of the sulphide and fluoride of divalent europium which support this view. To prepare europium fluoride, EuF_2, the trivalent fluoride, EuF_3, was reduced in a stream of hydrogen at a red heat. An impure europium sulphide, EuS, was obtained by heating the oxide Eu_2O_3 in a current of hydrogen sulphide. It was pure violet in colour, but contained some oxysulphide. The pure sulphide was obtained by heating europium sulphate, $Eu_2(SO_4)_3$, in a current of hydrogen sulphide. It was brownish-violet in colour and was pyrophoric when gently warmed. Efforts to make the oxide EuO were unsuccessful. The crystal structures of the sulphide and fluoride were determined by the usual methods. The sulphide EuS has a lattice of the sodium chloride type with $a = 5{\cdot}957 \pm 0{\cdot}002$ A. The ionic radius of Eu^{++} obtained from this is 1·24 A. Europium fluoride, EuF_2, has the fluorite structure. Comparison of the lattice constants with those of strontium and barium fluorides shows that in this respect europium compounds approximate more closely to strontium than to barium compounds.

Study of Atmospheric Dust

P. L. FAYETTE (*Thèse de Paris*, No. 487; 1938) states that although the first work on pulmonary diseases due to inhalation of dust dates from the eighteenth century, the first scientific work on the subject did not appear until the beginning of the

nineteenth century and was due to the researches of Laennec, Parent-Duchatelet and Virchow. Fayette describes the following groups of dust, inhalation of which may be injurious: (1) Microbial dust in which the number of germs varies according to the site, season and atmospheric conditions. (2) Dust with a local chemical action giving rise to silicosis. (3) Dust containing particles of coal or tobacco which merely causes a change in the colour of the lung without producing disease. (4) Dust containing substances such as wool, cotton, silk, pollen and drugs which give rise to a number of allergic diseases. The campaign against dust, which is more advanced in Great Britain and the United States than in France, is of special importance in industrial hygiene, in which medical selection and supervision of workmen exposed to the inhalation of dangerous dust are very desirable.

Atmospheric Pollution at Wellington, N.Z.

METEOROLOGICAL OFFICE NOTE No. 19, of the Department of Scientific and Industrial Research, New Zealand, is an extract from the *New Zealand Journal of Science and Technology*, in which an analysis is given by C. E. Palmer of observations of atmospheric pollution at Wellington, N.Z. They were made with the aid of a dust counter of the type designed by Owens, and extend at irregular intervals over a period of four years. They are not numerous enough to give a comprehensive survey even for the limited area of Wellington in which they were made, but nevertheless afford some interesting comparisons with similar data in other towns that are less fortunate than Wellington in the matter of pollution. The apparatus provides for the sudden cooling by expansion of air already saturated with water vapour, which leads to supersaturation and the condensation of the excess on ions, hygroscopic nuclei and dust particles present in the sample of air under examination. The resulting droplets adhere to a slip of glass and can then be examined under the microscope. A table is given showing the relative numbers of different types of particle and also the accompanying meteorological conditions, the particles being classified under four main headings: (*a*) separate black smoke spheres, large and small, the small being at or near the limit of visibility with a 1/12 in. oil immersion objective, while those distinctly visible were classified as large; (*b*) aggregates of smoke spheres; (*c*) hygroscopic crystals, and (*d*) glassy particles. The separate smoke spheres are much the most numerous and the glassy particles the least numerous although of relatively large size (generally 10–20 μ in diameter). The average number of particles of all kinds per cubic centimetre was 184, whereas Kidson found about 500 in Melbourne, and in London the figure is more like 10,000.

Accuracy of Meteor Data

IN a recent paper, Mr. J. G. Porter has dealt with 102 meteors doubly observed by Mr. J. P. M. Prentice and Mr. G. E. D. Alcock (*J. Brit. Astro. Assoc.*, **48**, 9; July 1938). The paths of these have been computed, and Mr. Porter has made a brilliant analysis of the data with the object of discovering possible sources of observational errors. It is well known to meteor observers, and more so to computers of their real paths, that one or more observers will frequently miss a portion of the path, either beginning or ending or both. British observers have generally aimed at recording *directions* of flight with great accuracy, and their object has usually been attained. Admittedly they often miss a portion of the beginning or ending, but this does not prevent a computer from determining the radiant, which depends upon direction and not on length of flight. Mr. Porter's paper shows conclusively that there are also small errors in direction—"errors in altitude"—and that the end of the path is more accurately observed than the beginning, a conclusion that one would expect from the fact that when a meteor is seen its path and end can be followed with considerable accuracy, whereas its exact beginning can be recorded only when the observer is looking towards that particular portion of the heavens. As the errors are distributed at random, according to the analysis, the arithmetic mean of the computed heights is the best value to adopt, and the mean deviation can then be taken as a criterion of the weight of the path. It is pointed out that the harmonic mean of the computed velocities should be used to obtain the greatest accuracy—a method adopted by Öpik some years ago—and an elementary proof is supplied for the reader. Estimates of magnitudes should, it is suggested, be given as mean zenithal magnitudes, the reduction being effected by the formula, $m = 5 \log \sec z$, where z is the zenith distance of the meteor when observed, and m is the magnitude reduction.

Origin of Binary Stars

DR. RAYMOND A. LYTTLETON has recently published a paper (*Mon. Not. Roy. Astro. Soc.*, **98**, 8; June 1938) in which he casts serious doubts on the theory of the origin of binaries by fission. A brief discussion of the fission problem is given, with reference to the work of Poincaré, Darwin, Liapounoff and Jeans, who investigated the configurations of equilibrium of a rotating mass of gravitating liquid of uniform density, especially that part of the problem which dealt with the secular stability of the pear-shaped figure. Jeans showed that this pear-shaped figure is secularly unstable, and within recent years Cartan has shown that it is also ordinarily unstable, so that once the pear-shaped series is reached, the relative motion of the parts is no longer slow and oscillatory. From this point the motion cannot be traced by a series of definitely equilibrium configurations; the system departs in an exponential manner from the critical configuration and it is possible to advance a number of general considerations indicating the result of this instability, though the motion cannot be followed rigorously. Dr. Lyttleton discusses the matter and deals with the two cases which arise for consideration: (1) The smaller body may be endowed with insufficient velocity to escape from the larger body. If, however, the smaller comes within the Roche limit, as it would do, disruption would occur. The assumption of nearly equal masses made by Jeans is inadmissible because there is insufficient angular momentum in the critical ellipsoidal form. (2) The smaller body may escape altogether from the larger—a view which is shown to be much more likely. The fission theory is unable to explain systems in which the mass-ratio is less than 3 : 1, and as similarity of mass is the rule rather than the exception in spectroscopic binaries, it seems that the origin of binary stars by fission must be discarded, as well as deductions from it relating to the time-scale.

Vector Maps and Crystal Analysis

By Dr. Irving Langmuir and Dr. Dorothy Wrinch

IN a series of communications, Patterson[1] and Harker[2] have introduced a new method of exhibiting the data contained in X-ray photographs of a crystal with the view of facilitating the use of such data for the determination of the atomic arrangement in the crystal. The essential feature of this type of analysis lies in the use of special Fourier series by means of which it is theoretically possible to construct a three-dimensional 'vector' map of a crystal, regarded as a distribution in space of positive and negative point intensities, superposed upon a continuously varying volume distribution of electrons. These maps represent, not the distribution of the point intensities in space, which is of course the objective of crystal analysis, but vector distances between them taken two at a time. The question then arises as to how far it is possible to derive from point intensity distributions in 'vector' space, S_2, corresponding point intensity distributions in 'atomic' space, S_1.

Vector diagrams, that is, sections and projections of vector maps, have been constructed in a few cases including proustite[2], pyrargyrite[2], and pentaerythritol[3]. Supplemented by data relating to the chemical composition, density, etc., of the crystal, they have been used in the determination of these structures. Some vector diagrams have also been constructed for an insulin crystal[4].

Previous to the construction of these diagrams, a structure, namely, the cyclol cage C_2, was proposed for the insulin molecule[5]. Investigations were consequently undertaken[6,7] to ascertain whether these diagrams confirm this structure or (as has been stated[4,8]) fail to confirm it, in the course of which it became clear that simple geometric arguments make it possible to go a long way towards interpreting these diagrams, and presumably other vector diagrams also, even when nothing whatever is known about the chemical composition, size, shape or density of the insulin molecule. In this communication a preliminary sketch is given of the geometrical method developed in these investigations, since it appears to have a wide field of applicability in the interpretation of vector maps, whether they are derived from molecular or megamolecular lattices.

We consider first vector maps which result from various simple distributions of point intensities. Suppose in atomic space S_1 there are two points A, B with intensities $\pm r$, $\mp s$ respectively. To construct the vector map in space S_2 of this distribution in S_1, we select any point O as origin in S_2 and erect at O vectors corresponding to the vector distances from A to A, from B to A, from A to B, and from B to B, associating with AA, BA, AB and BB, the end points of these vectors, intensities r^2, $-sr(=-rs)$, $-rs$ and s^2 respectively. We may write this result in the form

$$V(\pm rA \mp sB) \equiv (\pm rA \mp sB,\ \pm rA \mp sB) = r^2AA - srBA - rsAB + s^2BB \quad \ldots (1)$$

Here the points AA and BB lie at the origin O, and since the steps from B to A and A to B in S_1 are equal and opposite, the points BA and AB in S_2 are symmetrically placed with respect to the origin. We notice that points in S_2 obtained from pairs of points in S_1 with intensities of the same sign have positive intensities, those obtained from pairs of points in S_1 with intensities of opposite signs, negative intensities; also that the magnitude of the intensity at O is the sum of the squares of the intensities of the points in S_1.

Now the expression on the right of (1) is the formal expansion of the expression $(rA-sB)^2$, and the generalized expression

$$V\left(\Sigma_n r_n A_n\right) \equiv \Sigma_n r_n^2 A_n A_n + \sum_{m \neq n} r_n r_m A_n A_m \quad \ldots (2)$$

similarly gives the method of constructing vector maps for any set of point intensities in any dimensions. This binomial formulation of the structure of the vector map of a set of points not only makes it simple and easy to be sure that all the requisite terms have been considered: it also indicates the type of mathematical problem upon the solution of which the interpretation of vector maps depends. It is essentially akin to the problem of finding a square root; indeed interpretation of vector maps is the art of deducing the positions of n points in space S_1, from the positions of n^2 points in S_2.

To apply these ideas to crystals, we consider distributions of point intensities which are periodic. Thus if in S_1 there is a one-dimensional distribution, consisting of points of intensity $\pm r$ alternating with points of intensity $\mp s$ at even distances, the vector map in S_2 has the same unit cell and comprises at cell boundaries an intensity of $r^2 + s^2$ and at midpoints intensities of $-2rs$.

A second illustration—a two-dimensional crystal in which the unit cell is rhombic—is shown in Fig. 1*a*. The repeating unit consists of a hexagon of points of intensity $\pm r$, at the centre of the hexagon a point of intensity $\mp s$, in addition a point of intensity $\pm t$, arranged as shown. The vector map, periodic in the same unit cell, is shown in Fig. 1*b*. It contains points with intensities $2r^2$, r^2, $2r^2 - 2rs$, $2rt$, $-2st$. (In the figures, relative intensities are indicated by the areas of the circles. They have been drawn for the particular case in which in S_1 $r : -s : t = 8 : -6 : 3$, so that the intensities in S_2 are in the ratio $2r^2 : r^2 : 2r^2 - 2rs : 2rt : -2st = 32 : 16 : 8 : 12 : -9$).

A third example relates to a three-dimensional crystal in which the rhombohedral cell contains one molecule consisting of points of intensity $\pm s$ at the corners of an octahedron and a point of intensity $\mp o$ at its centre. The molecules are arranged with one trigonal axis along the trigonal axis of the crystal. Fig. 2*a* shows the *c*-plane projection of the crystal in S_1. Fig. 2*b* shows the corresponding projection of its vector map in S_2, in which there are points the intensities of which are $2s^2$, s^2 and $2s^2 - 2os$.

The S_2 projection shows that the molecules in S_1 are trigonal and that the molecular and crystal hexagonal axes are not coincident but make an angle with one another (say 6° in the figure). The dimensions of the molecule are obtained when it is realized

that the distribution around the cell corners in S_2 implies a distribution around the cell corners in S_1 of half the dimensions. The relative intensities of the points A, B (s^2 and $2s^2$ respectively) make it possible to interpret the intensities on an absolute scale. Finally, the lower intensity of the point C, which contains a term $2s^2$, demonstrates the presence of an intensity at the centre of the molecule the sign of which is opposite to that of s, which, contributing, with the s points, a negative intensity $-2os$ to C, reduces the total intensity there to $2s^2 - 2os$.

The illustrations given above have been selected, not only because they indicate the essentials of the geometrical method of approach to the problem of interpreting vector maps, but also because they are directly relevant to the case of insulin. Thus, in Fig. 2b, the positions of the maxima A, B, C found in the c-plane projection of the vector map of an insulin crystal calculated from X-ray photographs are reproduced[9]. The points associated with the hexagons obtained from the C_2 cages are also shown. The superposability of these two sets of points

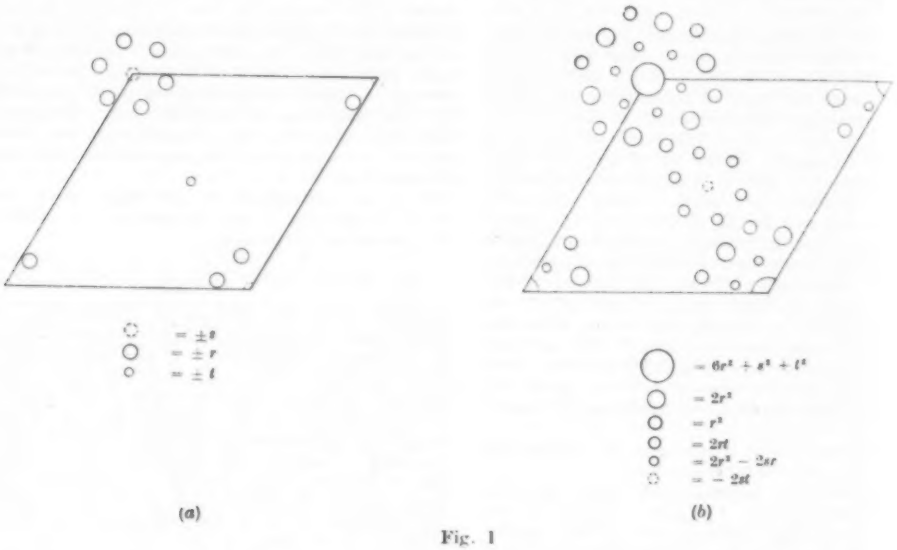


Fig. 1

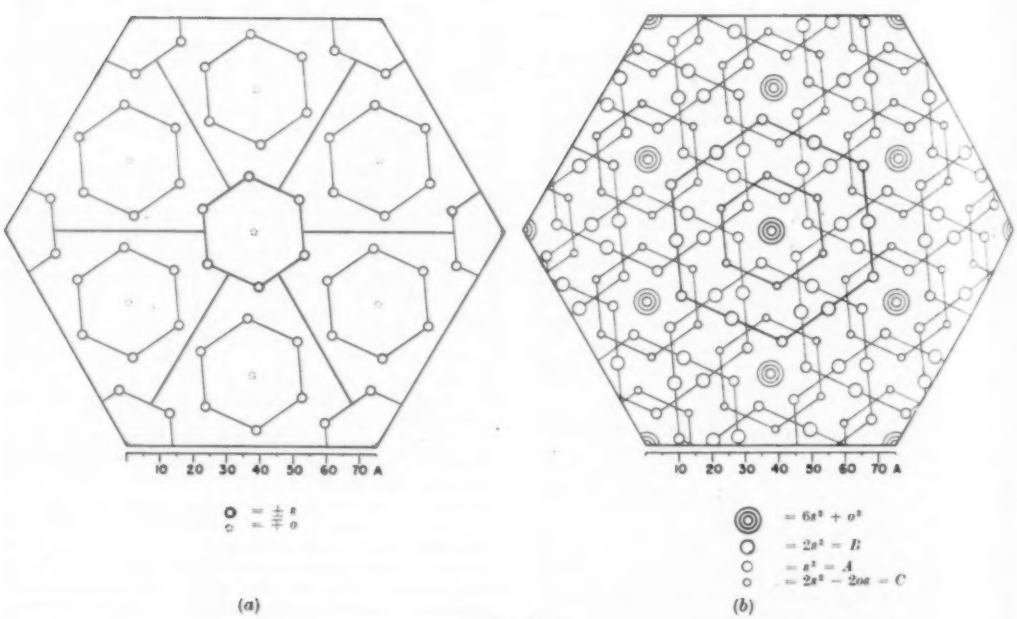


Fig. 2.

represented the first stage in the proof of the correctness of the C_2 structure proposed for insulin[6]. Fig. 2*a* indicates the size and orientation of the molecules in the insulin lattice, deduced from the vector diagram, Fig. 2*b*.

Again, Figs. 1*a* and *b* show how it proved possible[7] to deduce from the vector section, $z = \frac{1}{2}$ [10], the presence and position of three 'foreign' high intensity points per molecule in the lattice, nothing whatever being assumed about the chemical composition of the crystal. The images in Fig. 1*b* around the cell corners and around the middle point of the cell of the original distribution around the corners of the cell in Fig. 1*a* show how the existence and size of the negative intensity region at the centre of the insulin molecule was also deduced from this section[7]. These investigations, showing that it is possible to deduce that the insulin molecule is a polyhedral cage structure of the shape and size predicted, give some indication of the powerful weapon which the geometrical method puts at our disposal.

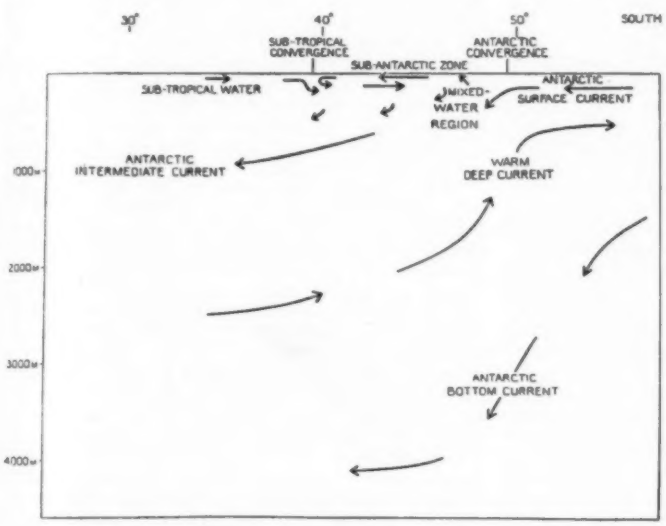
[1] Patterson, *Phys. Rev.*, **46**, 372 (1934); *Z. Krist.*, **90**, 517 (1935).
[2] Harker, J., *Chem. Phys.*, **4**, 381 (1936).
[3] Llewellyn, Cox and Goodwin, *J. Chem. Soc.*, 883 (1937).
[4] Crowfoot, *Proc. Roy. Soc.*, A, **164**, 580 (1938).
[5] Wrinch, *Science*, **85**, 566 (1937); *Trans. Faraday Soc.*, **33**, 1369 (1937).
[6] Wrinch, *Science*, **88**, 148 (1938).
[7] Wrinch and Langmuir, *J. Amer. Chem. Soc.*, in the Press.
[8] Bernal, *Réunion Internationale de Physique, Chimie et Biologie*, Paris, 407, 1937.
[9] Crowfoot, *loc. cit.*, Fig. 1.
[10] Crowfoot, *loc. cit.*, Fig. 3.

Marine Research in the Antarctic

THE wide scope of the investigations undertaken by the Discovery Committee in the Antarctic is well shown by the contents of their most recent reports[1]. First comes an account of the hydrology of the Southern Ocean by G. E. R. Deacon, which includes two results fundamental to an understanding of world water movements.

Of recent years the origin of the ubiquitous Antarctic bottom water, which in the Atlantic reaches as far as 40° N., has stimulated oceanographers. As a result of the 1932–33 circumpolar cruise of *Discovery II*, we can no longer suppose that this bottom water is formed by the sinking of shelf water all round the Antarctic Continent. Deacon now believes it to arise in, and only in, the south-western and western parts of the Weddell Sea. While moving eastwards, it incorporates water from the warm deep layer—now shown to exist throughout the whole of the Antarctic Zone—and the resultant highly saline bottom water flows northwards in the Atlantic, Indian and Pacific Oceans. It is the heaviest water in the sea.

On all sides of the Pole, Antarctic surface water also spreads northwards in a shallow surface layer until it reaches the Antarctic convergence. There it plunges abruptly to a deeper level to continue its course as the Antarctic intermediate current. The sharpness and constancy of position of the convergence is now shown to be governed by the movements of the warm deep water and the Antarctic bottom water. The northward movement of the latter depends on the configuration of the bottom. The sections at the end of the report suggest that near the convergence the bottom water is flowing steeply downhill to the ocean abyss. As to whether this is always so the text is not very clear. At any rate, where the southward moving deep water is opposed by a large volume of Antarctic bottom water, the former is forced up from below 2,000 metres to within 200 metres of the surface. Over this ascending warm deep water, the northward moving Antarctic surface water flows like a cascade to become the Antarctic intermediate current. Room is then left above for the warmer and lighter sub-Antarctic surface water. This picture appears to apply not only to the South Atlantic but also to the Indian and South Pacific Oceans as well.



VERTICAL CIRCULATION OF WATER IN THE SOUTH ATLANTIC OCEAN. FROM DISCOVERY REPORTS, VOL. 15.

There follows an account by A. W. B. Powell on marine mollusca from New Zealand waters, describing six new genera, 128 new species and thirteen genera previously unknown there.

Of the problems in the Antarctic requiring scientific study, perhaps the most urgent is the effect on the stock of Blue whales of modern intensive whaling

methods. A. H. Laurie finds that Blue whales reach physical maturity at ten or eleven years of age and that they breed only once in two years at most and often only every third year. The length of female Blue whales has decreased so much that on an average they are caught before they have had time to reproduce at all. Continued fishing on the present scale must have a disastrous effect on the stock. As Laurie points out, when killing has reached the point at which recruitment shall virtually have ceased, the future of Blue whales and whaling will be limited to the lifetime of those whales now living. Shall it be said of whaling as may now be said of other branches of the fishing industry: *inopem me copia fecit?*

[1] Discovery Reports, vol. 15. Title page and Contents. Pp. vi. 9*d*. net. The Hydrology of the Southern Ocean. By G. E. R. Deacon. Pp. 124+44 plates. 30*s*. net. Notes on the Dynamics of the Southern Ocean. By G. E. R. Deacon. Pp. 125–152. 4*s*. net. New Species of Marine Mollusca from New Zealand. By A. W. B. Powell. Pp. 153–222+plates 45–56. 15*s*. net. The Age of Female Blue Whales and the Effect of Whaling on the Stock. By A. H. Laurie. Pp. 223–284. 9*s*. net. (Cambridge: University Press, 1937.)

Progress in Building Research

A MATTER of considerable importance dealt with in the report for the year 1937 of the Building Research Board, by Dr. R. E. Stradling, director, is the account of the work done in connexion with "Soil Mechanics". This is a new and rapidly developing branch of engineering science which, it is felt, has not received from practising engineers in Great Britain the measure of recognition accorded to it elsewhere. The report therefore lays especial stress on the importance of recent developments in this direction. In the past, it is pointed out, such civil engineering problems as those associated with foundations and the stability of cuttings and embankments, have had to be dealt with on an empirical basis. As the necessary scientific knowledge did not exist this was inevitable; but a new school of thought has arisen and, following the lines explored by Terzaghi and others, the Station has been engaged in a programme of research. In this it has been actively assisted by the Earth Pressures Committee of the British Association, and by an Earth Pressures Sub-Committee set up by the Institution of Civil Engineers. Abroad, the results of research have had a large measure of application and there are reported to be signs of increasing attention here, the inquiries received at the Building Research Station being taken to show that engineers are becoming more fully aware of the assistance which this new science can give in promoting accurate and economical design. This increased interest has had the result that the soil mechanics section at the Station has been strengthened and it is hoped, with the support of outside bodies interested in its aims, to extend its operations and so to hasten the work of fundamental research and the solution of problems of immediate practical interest.

The two avenues of soil research which have been mainly followed at the Station are in connexion with the settlement of structures and the stability of earth slopes. In its method of dealing with the former the development of this science has led to a complete change in the mode of approach to this type of problem. In the past, it was held that the type of soil alone governed the pressure which could be imposed upon it. From the accumulation of practical experience, certain broad rules were evolved and, as a result, the so-called 'bearing values' of different soil types were embodied in tables which formed the basis of design. In difficult or doubtful cases loading tests might be carried out, usually on comparatively small areas, in an endeavour to assess the bearing value in these cases.

The new mode of approach is through an understanding of the mechanism by which settlements take place and, considering the structure itself, the relative amount of settlement permissible as between one part of the structure and another is regarded as the determining factor in the design of the foundations. It is to the work of Terzaghi and his followers that an appreciation of the broad aspects of the problem is due. Although, as the report states, the mechanism by which settlements occur has not as yet been fully explained, it is understood that settlement depends not only on the type of soil immediately below the footings but also on the nature of the soil strata to a considerable depth. A deep-seated stratum of soft clay may be, and indeed has often been, the cause of serious settlement. Apart from the influence of the pressure on a footing, settlement depends on the size of the footing, the depth at which it is placed and the presence of other footings in the immediate proximity. In the case of clay soils, time is also an important element, for settlement continues at a diminishing rate for a period determined by the conditions, and failure may occur some time after the completion of the structure. With so many factors entering into the problem, the difficulty in interpreting the results of loading tests and in appraising the limitations associated with them becomes obvious.

In the second part of the report, which contains the more detailed account of the Station's activities during the year, an outline is given of the methods employed in estimating and analysing the settlement of a structure. It is based on the laboratory examination of soil samples taken in an 'undisturbed' condition from several strata beneath the structure. From the results of tests made with the Terzaghi oedometer together with calculation of the distribution of pressure from the building, it is possible to estimate the amount of settlement to be expected. It may be objected that the conditions of the test do not actually reproduce those existing in practice, and this is acknowledged, but if, from actual measurements, agreement can be shown between the actual and the estimated movements, then a very great step forward can be recorded. This represents the present stage of development of the subject; every effort is being made to get information about such comparisons and, the more the work progresses, the more impressive does the closeness of the correlation appear. The results of work done in connexion with a new building for the Fire Testing Station, Elstree, will shortly be published and it is claimed that the agreement in this case is as near as one can hope to get. Further cases are under observation and, as the data from these become available, this method of testing and

analysis will be more firmly established. It certainly provides a much more accurate design technique than any other known method.

On the cognate subject of the stability of earth slopes, the report states that special opportunities have arisen during the year for the study of earth bank failures on a practical scale, and the various engineers concerned have given facilities for samples and measurements to be taken on the sites. It is now held that the stability of an earth slope depends upon the shear characteristics of the soil in the slope and in the foundation layers. The shear resistance of clay has been shown to depend on its cohesion, with the result that the maximum angle at which a clay slope can stand without support decreases rapidly with increasing height. This puts a new complexion on the problem, and the report shows how progress is being made to determine the properties of soils and how these and other aspects of it are being investigated.

These notes treat of but one of the many interests being dealt with by the Station, ranging from the homely problem of the smoky chimney through the whole gamut of building problems to research on the constitution and properties of materials. Both in its routine work and in special investigations the fact is clearly recognizable that the services of the Station are of great value to the building trade and to the nation, as well as to the promotion and development of applied science in a wide field.

Australian Echinoderms

DR. H. L. CLARK'S first papers on Australian echinoderms appeared in 1909 when he described the Australian forms in the Museum of Comparative Zoology, and the *Thetis* collection made off New South Wales and at Lord Howe Island. They proved to be the forerunners of a series, continued to the present day*, in which he has made known far more about Australian echinoderms than any other man. He has described the collection of the Western Australian Museum (1914); the many echinoderms, excepting the holothurians, taken by the *Endeavour* off the coasts of Queensland, New South Wales, Tasmania, Victoria, South and Western Australia (1916); a small collection from Western Australia (1923) and another from the Barrier Reef (1926); the very large collection, other than the holothurians, of the South Australian Museum (1928), mostly southern forms; and the echinoderms, other than asteroids, of the Barrier Reef Expedition (1932).

All but the first of these papers were on collections submitted to Dr. Clark, as an expert in another country, by Australian and other authorities. The collections comprised nearly 6,000 specimens among which were representatives of 113 new species. In the meantime, in 1913, Dr. Clark had been to Australia himself and had made a large collection in the Torres Strait. It was described in two papers in 1915 and 1921.

These notes on earlier papers are given as a background against which to see Dr. Clark's most recent work. They show that he had described a great deal of material from all coasts of Australia except the north-western, which remained a *terra incognita* in marine zoology. His most recent paper describes the very rich echinoderm fauna he found in the north-west and much additional material from all other coasts as well.

It is based on specimens which for the most part he himself collected, alongshore and by dredging, on his visits to Australia in 1929 and 1932. Treating the two visits as one, he spent six weeks at Darwin, visited two points on the coast between Darwin and Broome and spent three months at Broome; small collections were made, where echinoderms occurred, at five points between Broome and Perth, and three weeks collecting was done from Fremantle. There followed short visits to study the material at the Museums of Adelaide, Melbourne, Hobart, Sydney and Brisbane and collecting excursions from some of them. Finally, three weeks were spent at Lord Howe Island in the Tasman Sea.

Dr. Clark returned to America with more than 11,000 specimens of echinoderms of which he and his immediate helpers, including Mrs. Clark, collected nearly 10,000, the remainder being loans and gifts from museums and other sources in Australia. They represented 422 species of which 128 were new. The descriptions of the species are, as in Dr. Clark's papers on the Torres Straits collections, richer because the author saw them alive and observed their abundance and habits and colours. His descriptions of these things will be invaluable to those who may seek the animals in life. They are of great interest to students who cannot; for them Dr. Clark has described too the colours the species have when dried or kept in spirit—though it is often the dingy brown called 'museum colour'. There are eighteen beautiful coloured plates based on sketches made from life by Mrs. Clark; they and the coloured plates of the Torres Straits report must make the Australian echinoderm fauna one of the best illustrated in colour in the world.

The report falls into five sections corresponding to the five echinoderm classes. Before each, Dr. Clark tells us, among other things, where the members of this class are most abundant in Australian waters, in what sites they should be sought, and how they may best be fixed and preserved. Because the species of the starfish genus *Anthenea* are mostly Australian and Dr. Clark had a large series before him, he has discussed or described all the known species and given a key to them. In the ophiuroid section he has made a beginning with—what has long been overdue—a sub-division of the large genus *Ophiothrix*, starting with the long-armed species of the Indo-Pacific region. At the end of the volume are local lists of echinoderms for ten localities.

Dr. Clark has in earlier papers discussed the geographical distribution of the Australian echinoderm fauna and its relationships to that of other regions. Now that he has collected and described so much new material, a great deal of it from the hitherto unknown north-west, it is good to know that in a subsequent report he hopes to give a full account of the fauna as at present known, and to discuss its apparent history and relationships. D. D. J.

*"Echinoderms from Australia, an account of Collections made in 1929 and 1932" by Dr. Hubert Lyman Clark. *Mem. Mus. of Comparative Zoöl.*, **55**. Pp. 596 + 28 pls.

Science News a Century Ago

Engineering Education

THE *Athenæum* on September 29, 1838, in a review of some recently printed pamphlets, gave its views on engineering education. At the head of the review it mentioned the "Program des Cours de l'Ecole Centrale des Arts et Manufactures"; regulations for students in civil engineering in the University of Durham; arrangements for conducting the various departments of King's College, and the prospectus of the class of civil engineering and mining, University College, London. In the course of the review, the *Athenæum* remarked: "But no man pursues his trade or art successfully or well, who does not, beside the practice, possess the science of it; and the great distinction between artificers, for the most part practically equal, is this, that some have and some have not the knowledge of the science of their art. Science is everywhere aiding man in his contest with the physical difficulties of his position, and ministering to him new powers and capabilities of thought and action."

Treatment of Wounds by Heat

"THE rapid cicatrization of wounds by heat has been the object of several experiments made by Drs. Breschet and Jules Guyot. To severe wounds and amputations they apply a heat of 36° of the centigrade thermometer. The apparatus consisted of a box, carefully constructed, in which is a glass, through which the progress of the wound may be watched, and communicating with a tin tube, adapted to a lamp; precautions are taken to prevent the contact of the wound with the wood of the box, and a piece of linen or other material surrounds the orifice, and ties above the wound; when once adjusted, the apparatus is left on without any other application till the wound is healed. M. Larrey has remarked on this, that the heat of Egypt seemed to him to be highly favourable to the cure of wounds, inasmuch as they were healed in half the ordinary time; but he doubts whether the application of local and artificial heat will have the same effect as that of atmospheric air" (*Athenæum*, September 29, 1838).

Whitby and Pickering Railway

IN its early days, the Whitby and Pickering Railway, opened in 1836, was worked by horses, the carriages consisting of stage coaches with flanged wheels. It had heavy gradients and at one of these a tank was provided, mounted on railway-wheels, at the top of the incline. To assist in drawing a coach up the incline, the tank was allowed to descend the reverse slope and at the bottom the tank would be emptied. Airy, the Astronomer Royal, who was visiting Yorkshire at the time, wrote from Brampton, near Chesterfield, on September 30: "On Wednesday morning at 8 we started by the railroad (from Pickering) for Whitby in a huge carriage denominated the Lady Hilda capable of containing 40 persons or more drawn by one horse, or in the steep parts of the railway by two horses. The road goes through a set of defiles . . . descending in one part by a long crooked inclined plane, the carriage drawing up another load by its weight. . . . The rate of travelling was about 10 miles an hour. Betsy declares that it was the most agreeable travelling that she ever had."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **207**, 265–312, July 25, 1938).

E. JOUGUET: Secular stability when positional forces do not admit of potential.

A. COTTON: Remarks on a note of M. Brylinski entitled "On the symmetries of the magnetic field".

R. GARNIER: Extension of the Euler-Savary formula to the most general movement of a solid.

E. BAUMGARDT: A method for the determination of the adiabatic moduli of elasticity. Measurement of the speeds of ultra-sonic waves in three different directions through a cubic crystal would give data for calculating the three moduli of elasticity.

R. GRANDMONTAGNE: Colour of the night sky. New observations emphasize the importance of the red radiations.

D. G. DERVICHIAN and C. CLARK: Use of the ring method for the measurement of surface tension. A simple empirical relation is found.

E. BADAREU: Remarks on the explosive potential in benzene vapour.

R. FORRER: Cause of the anomaly of magnetite at low temperatures. There are two kinds of magnetite, distinguished chemically by the power of adding on chlorine. That which does not add on chlorine shows, in a thermomagnetic apparatus, a sudden increase of magnetization at − 138° to − 118° C. The anomaly is thus attributed to a bond between two iron atoms generally considered divalent but actually trivalent.

R. SERVANT: Rotatory power of quartz in the far ultra-violet and in the Schumann region.

G. COSTEANU: Raman spectrum of ammonia and of the ammonium ion.

M. DODÉ and B. PONTECORVO: A radio-element produced in cadmium under the action of rapid neutrons.

MME. T. GUILMART: Study by reflection of the absorption spectra of organic substances in the solid state.

J.-J. TRILLAT and P. NARDIN: Influence of temperature on the interfacial tension of the system castor oil - water. Rise of temperature opposes orientation.

H. GAULT and A. CHABLAY: Kinetic study of the phenomena of acidolysis.

H. VINCIENNE: Alteration of cretaceous flints in the Upper Sands of the Perte du Rhône, at Bellegarde.

C. SAUVAGE: Germination of *Lepidium sativum* L. in presence of salt.

P. RIOU and G. DELORME: Distribution of iron and manganese in the maples of the Province of Quebec.

L. RAPKINE: Role of sulphydryl groups in the activity of triosephosphate oxidoreductase.

RAYMOND-HAMET: Secondary vasodilatory action of adrenalin.

M. LAFON: The qualitative requirement of nitrogen in *Drosophila melanogaster* Meig.

M. POLONOVSKI and P. BOULANGER: Influence of the structure of amino-acids on ammonia in the renal blood vessels.

J. CAMINOPETROS, D. COMNINOS and MLLE. DERVOU: Experimental study of a virus isolated from the cephalorachidian fluid of a case of post-vaccinal meningo-encephalitis.

Brussels

Royal Academy (*Bull. Classe Sci.*, **24**, No. 4; 1938).

G. CESÀRO and J. MÉLON: The crystalline form of acmite. A form $\overline{7}2$, 75, 10 or $\overline{4}3$, 45, 6, preponderant in all the crystals studied, a prism to which the writers have erroneously assigned a symbol of the form $\overline{h}h1$. Simplification of Brögger's notation taking the face $\overline{2}01$ as base.

L. GODEAUX: A configuration formed by two Laplacian sequences.

E. DE WILDEMAN: Sterility, senescence and disappearance of species in plants.

O. ROZET: Non-cyclic involutions of order twenty-seven belonging to an algebraic surface.

Calcutta

National Institute of Sciences of India (Aug. 20, 1938).

SIR LEWIS FERMOR: Notes on vredenburgite (with devadite) and on sitaparite.

N. N. CHOPRA: The role of nitrogen compounds in the fermentation of fruit juices.

S. C. PILLAI: A biochemical investigation of the tuberculation of water pipes.

M. N. SAHA and R. N. RAI: Ionization of the upper atmosphere.

S. M. SULAIMAN: Levi-Civita's formulæ for two bodies.

Rome

National Academy of the Lincei (*Atti*, **27**, 189–266; 1938).

G. A. BLANC: Geochemical interpretation of the quaternary formations of Grotta Romanelli (Terra d'Otranto). (1) Data of the problem and method of investigation.

S. FAEDO: Rational surfaces with canonical hyperplane sections and a paradox relative to their singularities (1).

B. SEGRE: (1) Families of isoparametric hypersurfaces in Euclidean spaces in any number of dimensions. (2) Systems of linear equations with constant coefficients having partial derivatives of any order with only one unknown function.

C. TOLOTTI: Cauchy's problem in the non-analytical case.

M. VILLA: A class of V_k varieties situated on the Veronese cones.

G. COLONETTI: The second principle of reciprocity and its applications to the calculation of permanent deformations (3).

L. VENTURELLI: Einstein's statics in a gravitating fluid mass.

G. BOAGA: Gravimetric campaign in Sardinia.

A. BARONI: Telluro-mercaptans.

A. SALVATORI: Chlorine content of the organs and tissues of the rat in relation to their age.

V. ZAGAMI: Action of vagi on the metabolism of glycides (2). Behaviour of the cardiac, hepatic and muscular glycogen after administering insulin in vagotomized pigeons.

Atti, **27**, 267–316; 1938.

G. A. CROCCO: Factors of the static-kinetic stability of aircraft.

S. FAEDO: Rational surfaces with canonical hyperplane sections and a paradox relative to their singularities (2).

M. HAIMOVICI: ds^2 binaries with given total curvature.

F. SBRANA: Some questions relating to plane and oblique curves.

T. FRANZINI: Method of working of a proton tube.

C. GUARESCHI: The nucleus of the salivary glands of the larvæ of *Chironomus plumosus* studied in a dark field, in polarized light and by means of the Feulgen reaction.

G. MORUZZI and G. BORGATTI: Action of bromine on the development of the organism.

R. RUBINI: Behaviour of the *p*H of human urine during the daytime.

D. GIGANTE: Percentage loss of weight in death through inanition and through hypo-alimentation.

Washington, D.C.

National Academy of Sciences (*Proc.*, **24**, 303–364, August 15, 1938).

P. C. MANGELSDORF and R. G. REEVES: Origin of maize. A genetical investigation, supported by archæological evidence, suggests that cultivated maize originated in South America as a single gene mutation from a wild form of pod-corn. *Euchlæna*, formerly considered a progenitor of maize, is probably a recent natural hybrid of *Zea* and *Tripsacum* (another American genus) which arose in Central America; the majority of North American varieties arose from this cross.

S. E. HILL and W. J. V. OSTERHOUT: Calculations of bio-electric potentials. (3) Variation in partition coefficients and ion mobilities.

H. BATEMAN: (1) Rayleigh waves. A theoretical discussion leading to the view that when the ground rises after an underground explosion, the air immediately above it either moves away laterally and produces a reaction on the ground elsewhere, or will tend to compress the great body of air above it. This has a bearing on earthquake noises. (2) Coulomb's function.

M. MORSE: Functional topology and abstract variational theory.

H. S. VANDIVER: Criteria concerning singular integers in cyclotomic fields.

G. A. MILLER: Groups of degree n involving only substitutions of lower degrees.

J. L. WALSH and W. SEIDEL: Derivatives of functions analytic in the unit circle.

A. D. MICHAL: Differential calculus in linear topological spaces.

J. DOUGLAS: (1) Minimal surfaces of higher topological structure. (2) Green's function and the problem of Plateau. (3) The most general form of the problem of Plateau.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

DEMONSTRATOR IN BACTERIOLOGY at King's College, Newcastle-upon-Tyne (University of Durham)—The Registrar (October 1).

POULTRY PATHOLOGIST in the Agricultural Advisory Centre, University of Bristol—The Registrar (October 6).

CHEMIST-IN-CHARGE and CHEMISTS at the Royal Ordnance Factory, Irvine, Ayrshire—The Under-Secretary of State (C.S.), The War Office, London, S.W.1 (October 7).

DIRECTOR of the Imperial Veterinary Research Institute, at Muktesar, United Provinces, India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 7).

LECTURER IN PHYSIOLOGY AND HYGIENE in the University of Leeds—The Registrar (October 8).

ASSISTANT LECTURER IN PHYSICS in the University of Sheffield—The Registrar (October 10).

DIRECTOR OF DAIRY RESEARCH in India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 10).

Two appointments in the MECHANICAL ENGINEERING AND TRANSPORTATION (POWER) DEPARTMENT of the Indian State Railways—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 14).

A PROFESSOR OF MALARIOLOGY AND RURAL HYGIENE and a PROFESSOR OF VITAL STATISTICS AND EPIDEMIOLOGY in the All-India Institute of Hygiene and Public Health, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 21).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1937. Pp. v+266. (London: H.M. Stationery Office.) 4s. net. [29

Mines Department. Sixteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1937. Pp. 136+15 plates. (London: H.M. Stationery Office.) 2s. net. [59

Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part 3: The Effect of Commercial Pasteurisation on the Nutritive Value of Milk as determined by Experiments on Calves. Pp. 27. (Reading: National Institute for Research in Dairying.) 2s. [79

Ministry of Health. Memorandum on Smallpox. (Memo. 215 Med.) Pp. 8. (London: H.M. Stationery Office.) 2d. net. [89

Proceedings of the Royal Society of Edinburgh, Session 1937–1938. Vol. 58, Part 2, No. 12: Green's Function for an Ellipse, and its Application to the Motion of a Point Vortex. By Dr. D. Mekryn. Pp. 176–180. 6d. Vol. 58, Part 2, No. 13: The Brackish-water Lochs of Orkney. By Dr. Edith A. T. Nicol. Pp. 181–191. 1s. Transactions of the Royal Society of Edinburgh. Vol. 59, Part 2, No. 13: Differential Fertility in Scotland, 1911–1931. Part 1. By Dr. Enid Charles. Pp. 371–383. 1s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [99

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1937. Vol. 72, Part 1: Acreage and Production of Crops, Number of Live Stock and of Agricultural Workers, and Output and Prices of Agricultural Produce in England and Wales. Pp. 109. (London: H.M. Stationery Office.) 1s. 6d. net. [129

Department of Scientific and Industrial Research. Deterioration of Structures in Sea-Water. Seventeenth (Interim) Report of the Committee of the Institution of Civil Engineers. Pp. iv+33. (London: H.M. Stationery Office.) 9d. net. [129

Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 686: An Economic Study of the Costs of Selling and Delivering Milk in the New York Market. By Charles Blanford. Pp. 60. Bulletin 687: Study of Artificial Incubation of Game Birds. 3: Effect of Air Movement on the Incubation of Pheasant and Quail Eggs; 4: Interrelation of Temperature, Humidity and Air Movement in the Incubation of Pheasant and Quail Eggs. By Alexis L. Romanoff. Pp. 30. Bulletin 688: Effect of Changes in Milk and Feed Prices and in other Factors upon Milk Production in New York. By Merton S. Parsons. Pp. 68. Bulletin 689: An Economic Study of Land Utilization in Clinton County, New York. By O. H. White. Pp. 52. Bulletin 691: Experiments in the Fattening of Lambs. By John P. Willman and F. B. Morrison. Pp. 28. Bulletin 693: Agricultural Production in New York, 1866 to 1937. By T. E. La Mont. Pp. 34. Bulletin 694: Early-cut, Nitrogen-fertilized Timothy Hay as compared with Alfalfa Hay for Feeding Dairy Cows. By G. W. Salisbury and F. B. Morrison. Pp. 30. Bulletin 695: The Membership of Farmers in New York Organizations. By W. A. Anderson. Pp. 28. (Ithaca, N.Y.: Cornell University.) [19

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1938. Pp. 28. Bulletin No. 6: A Synopsis of Forest Fungi of Significance in New Zealand. By. T. T. C. Birch. Pp. 17. (Wellington: Government Printer.) [29

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Comparative Pulverized Fuel Boiler Tests on British Columbia and Alberta Coals and on Ontario Lignite. By C. E. Baltzer and E. S. Malloch. (No. 790.) Pp. ii+54. (Ottawa: King's Printer.) 25 cents. [29

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. No. 82: Hydrobiologie piscicole du Bassin Moyen de la Lesse (Ardennes Belges). Par Marcel Huet. Pp. 128+4 plates. No. 83: Le Couvinien de l'Ardenne et ses faunes. Par Eug. Maillieux. Pp. 58+2 plates. No. 84: La faune des Couches de passage du Dinantien au Namurien dans le synclinorium de Dinant. Par Prof. F. Demanet. Pp. 201+14 plates. Deuxième Série, Fasc. 13: The Atlantic and Gulf Coast Tertiary Pectinidæ of the United States. Section 3: Systematic Descriptions. By Dr. H. I. Tucker-Rowland. Pp. 76+6 plates. Hors Série: Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 2, Fasc. 19: Prosobranchia et Opisthobranchia. Par W. Adam et E. Leloup. Pp. 209+8 plates. Vol. 3, Fasc. 18: Astéries et Ophiures. Par H. Engel. Pp. 31+4 plates. (Bruxelles: Musée Royal d'Histoire Naturelle.) [59

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 19: A Preliminary Annotated List of Fruit Pests of the North-West Frontier Province. By Dr. Hem Singh Pruthi and H. N. Batra. Pp. 18. 1 rupee; 1s. 9d. Miscellaneous Publication No. 20: Report on an Enquiry into the Cultivation of Cloves in India. By A. K. Yegna Narayan Aiyer. Pp. ix+75+3 plates. 2.4 rupees; 3s. 9d. (Delhi: Manager of Publications.) [59

Government of India Industrial Research Bureau. Report for the Year 1937–38. Pp. iv+38+3 plates. (Delhi: Manager of Publications.) [59

Department of Agriculture of South Australia. Bulletin No. 333: Vegetation Types associated with Plague "Grasshoppers" in South Australia. By H. G. Andrewartha, Dr. J. Davidson and D. C. Swan. Pp. 47. (Adelaide: Government Printer.) [59

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 118: A Soil Survey of the Horticultural Soils in the Murrumbidgee Irrigation Areas, New South Wales. By J. K. Taylor and P. D. Hooper. Pp. 108. (Melbourne: Government Printer.) [59

Crohamhurst Observatory. Eighth Observatory Paper: The Climate of Australia during the Hypothetical Jovian Sunspot Period 1901–1913, together with the Monthly and Annual Rainfall Observations at Selected Stations during that Period, and some Comments on the Evidences of Cyclical Reproduction of the Weather and the Immediate and other Effects of Sunspot Changes. Pp. 94. Report of the Crohamhurst Observatory for the Year ending 30th June 1938. Pp. 5. (Crohamhurst, Qd.: Crohamhurst Observatory.) [59

Smithsonian Miscellaneous Collections. Vol. 97, No. 6: Evolution of the Annelida, Onychophora and Arthropoda. By R. E. Snodgrass. (Publication 3483.) Pp. 159. (Washington, D.C.: Smithsonian Institution.) [69

Det Kgl. Danske Videnskabernes Selskab. The Eyak Indians of the Copper River Delta, Alaska. By Kaj Birket-Smith and Frederica de Laguna. Pp. 592+18 plates. (København: Levin and Munksgaard.) [79

Geological Survey of British Guiana. Bulletin No. 7: Report on a Geological Reconnaissance Survey of part of the North-West District. By S. Bracewell. With an Appendix containing a Report on the Geology of the Aruka District, by W. T. Lord. Pp. iv+37. 24 cents. Report No. 9: Report of an Area between Quartzstone Head, Aremu Mine and the Puruni River near Peters Mine. By D. W. Bishopp. Pp. ii+20. 12 cents. (Georgetown: Geological Survey.) [79

League of Nations: Economic Committee. Preliminary Investigation into Measures of a National or International Character for Raising the Standard of Living. Memorandum by N. F. Hall. (Official No.: A. 18. 1938. II.B.) Pp. 91. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. [79

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 90. The Phloxes of Oregon. By Edgar T. Wherry. Pp. 133–140. (Philadelphia: Academy of Natural Sciences.) [99

Royal Observatory, Hong Kong. Magnetic Results, 1937. Prepared under the direction of C. W. Jeffries. Pp. 51+2 plates. (Hong Kong: Royal Observatory.) 1 dollar. [129

League of Nations: International Committee on Intellectual Co-operation. Report by Prof. G. de Reynold on the Work of the Twentieth Plenary Session of the Committee. (Official No.: C.253. M.150.1938.XII.) Pp. 53. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2s. [129

League of Nations: Advisory Committee on Traffic in Opium and other Dangerous Drugs. Report to the Council on the Work of the Twenty-third Session, held at Geneva from June 7th to 24th, 1938. (Official No.: C.237.M.136.1938.XI.) Pp. 41. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 1s. 6d. [129

Summary Proceedings of the Thirty-sixth Meeting of the Indian Central Cotton Committee, Bombay, held on the 25th and 26th January 1938. Pp. 99. (Bombay: Indian Central Cotton Committee.) 1 rupee. [129

Ceylon. Part 4: Education, Science and Art (G.). Administration Report of the Acting Marine Biologist for the Year 1937. By P. E. P. Deraniyagala. Pp. G.16. (Colombo: Government Record Office.) 20 cents. [129

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 108, Part 1: Contributions to Special Scientific Meetings, 1938. Pp. xv+114. 5.00 kr. Vol. 108, Part 2: Light Measurements. Pp. 21. 1.00 kr. Vol. 108, Part 3: Salmon Migrations. Pp. 35. 1.50 kr. (Copenhague: Andr. Fred. Høst et fils.) [129

Lucknow University Studies. No. 2: Recent Advances in Indian Palæobotany. By Prof. B. Sahni. Pp. viii+102. (Lucknow: Lucknow University.) [129